A Survey on Graph Neural Networks for Microservice-Based Cloud Applications

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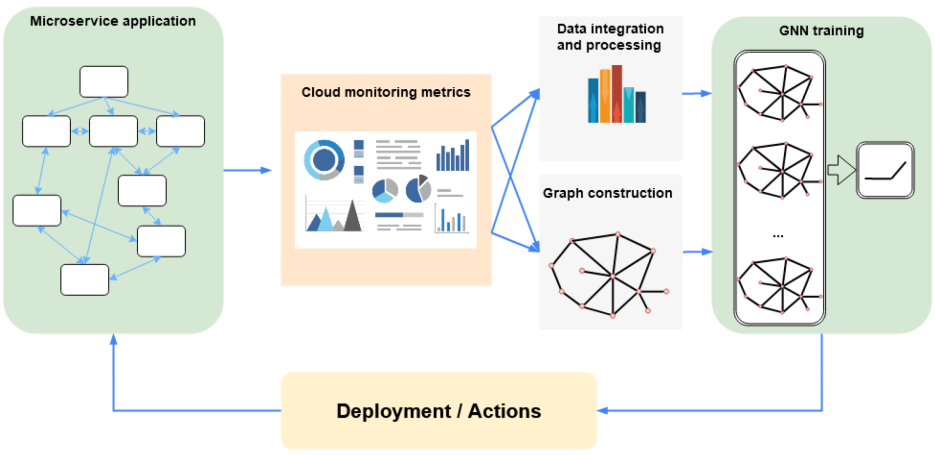
The Scope

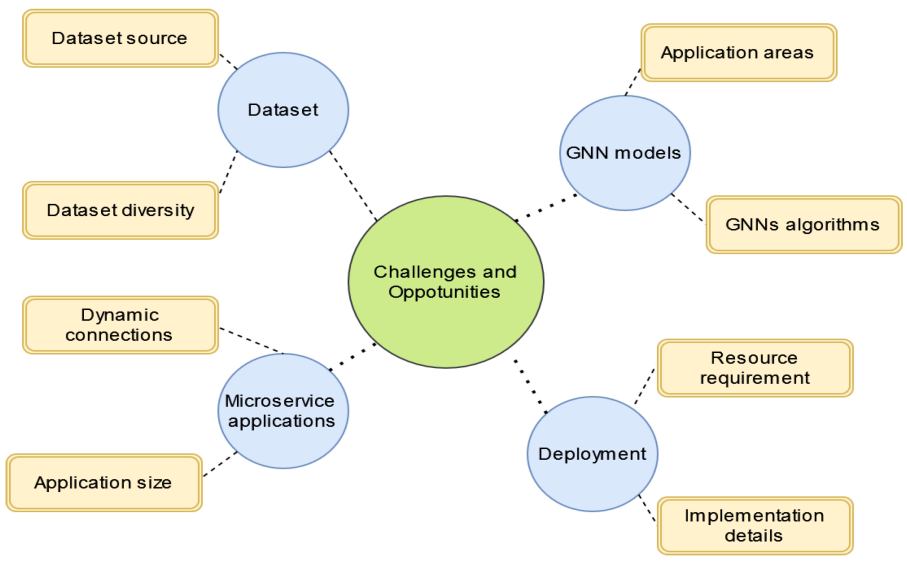
Nowadays, Graph Neural Networks (GNNs) are increasingly being adopted to address various technical challenges in microservice-based cloud applications from prototype design to large-scale service deployment. In this work, we present a thorough review of recent studies on the utilization of GNNs in this context. We identify the key areas in which GNNs are applied, and then we review in detail how GNNs can be designed to address the challenges in specific areas found in the literature. Also, we outline potential research directions where GNN-based solutions can be further applied.

Our contributions

- We review the basics of GNNs and their variants.
- We investigate the current development and application of GNNs for microservice tasks.
- We identify the key research areas where GNNs can be applied to microservice tasks.
- We summarise main technical challenges and research gaps in relation to GNN applications for microservices.
- This is the first review paper that attempts to highlight this new and advanced field of research where GNNs can be leveraged for microservice-based applications.



High-level flow diagram of GNN applications for microservices



The challenges and opportunities for GNNs for microservice architecture

GNNs in Microservice-based Applications

GNNs have been applied to the three areas of microservice-based applications, including Anomaly Detection, Resource Scheduling and Software Decomposition.

- Anomaly detection can be modelled as a graph learning problem where GNNs can be applied to extract features from neighboring nodes through message passing.
- GNN-based algorithms can be applied to dynamically adjust system resources in response to the workload and environments in a proactive manner.
- GNNs can be used to learn structure of software codes and identify the functions that are closely related.

Conclusion

We reviewed the utilization of GNNs in microservice-based applications for anomaly detection, resource scheduling, and software decomposition. Our results have shown that different GNN architectures can offer distinct benefits for applications in cloud systems. In general, GNNs have shown their ability to perform well in various tasks, such as node classification, node prediction, and graph construction. We suggest future research directions, including the applications of spatio-temporal graph neural networks and dynamic graph neural networks for more complex microservice applications which may help to further improve such systems in a variety of practical scenarios.

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