Decentralized Federated Graph Neural Networks

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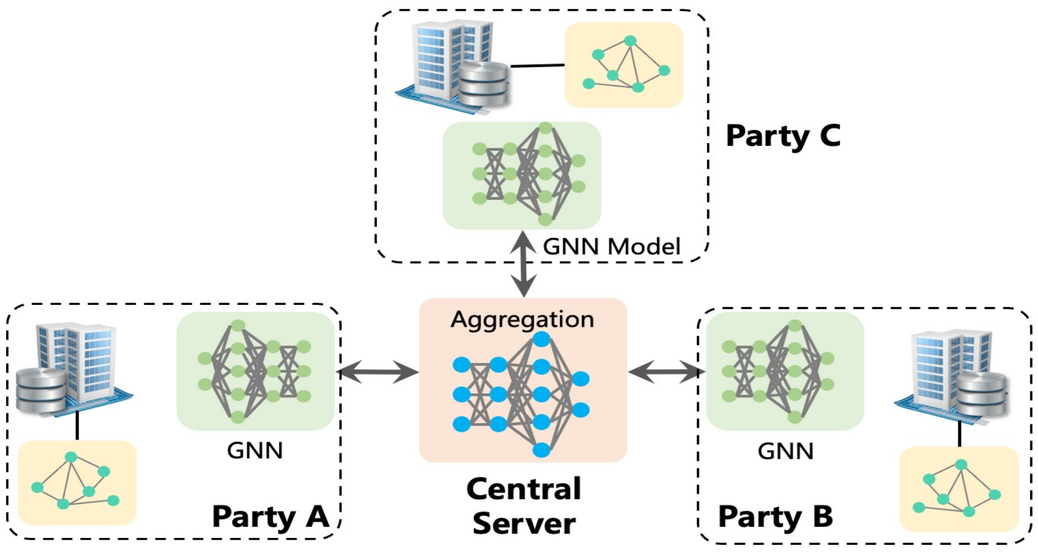
Introduction and Related Work

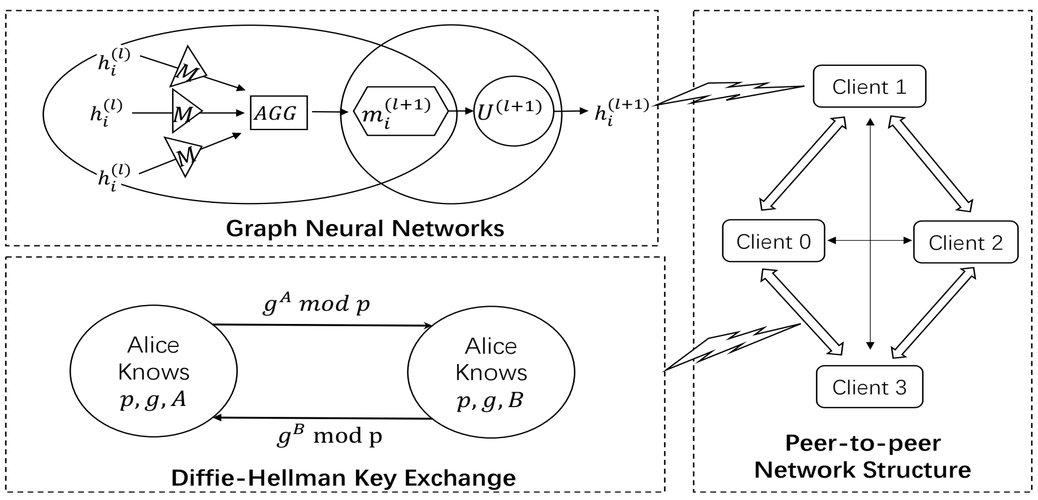


There are many works on centralized federated learning in which a central server is always required to conduct model aggregation. In this paper we proposed a decentralized federated learning algorithm with Diffle-Hellman Key Exchange Method. And we combined it with graph neural networks.

- We first study the problem of decentralized federated learning on graph data.
- We proposed a new D-FedGNN method based on DP-SGD algorithm and D-H Key Exchange Method to enable decentralized learning of graph neural networks with privacy protection.

Proposed Scheme

D-FedGNN System Framework



D-FedGNN mainly consists three parts, namely system setup and initialization, local model updating, and secure model aggregation.

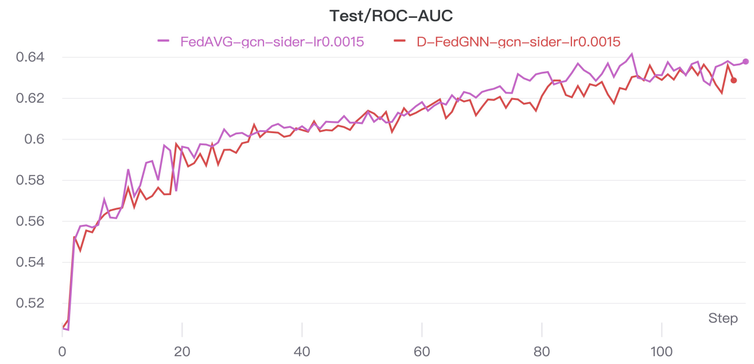
- At the first step, we do initialization of our algorithm, such as model parameters and communication matrix.
- Then clients train their model separately with their own data.
- At last, we aggregate model securely with Diffle-Hellman Key Exchange method for privacy protection.

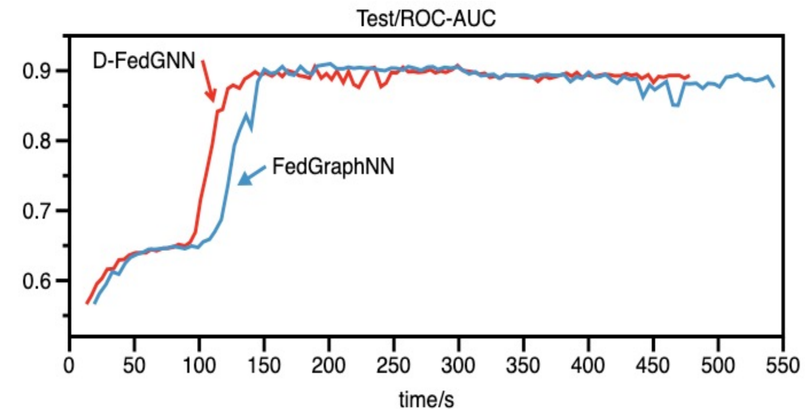
Experimental Setup and Evaluation Results

Experimental Datasets

Table 3: Summary of datasets

Dataset	Compounds	Average of Nodes	Average of Edges
ESQL	1128	13.29	40.65
FreeSolv	642	8.72	25.60
Lipophilicity	4200	27.04	86.04
hERG	10572	29.39	94.09
BACE	1513	34.09	36.89
BBBP	2039	24.03	25.94
SIDER	1427	33.64	35.36
ClinTox	1478	26.13	27.86
Tox21	7831	18.51	25.94





- D-FedGNN can achieve similar preformance to centralized federated learning algorithm on benchmark datasets.
- Compared with centralized federated learning algorithm, D-FedGNN has more balanced communication workload among clients, which makes it more practical in applications.

Conclusion

Advantages

- D-FedGNN enable training a graph neural network model without a central server.
- D-FedGNN can protect privacy during model updating using D-H Key Exchange Method .

Reference

[Bonawitz and et al., 2017]Keith Bonawitz and et al. Prac-tical secure aggregation for privacy-preserving machinelearning. Inproceedings of the 2017 ACM SIGSAC Con-ference on Computer and Communications Security, pages1175–1191, 2017.

[Lianet al., 2018]Xiangru Lian, Ce Zhang, Huan Zhang,Cho-Jui Hsieh, Wei Zhang, and Ji Liu. Can decentral-ized algorithms outperform centralized algorithms? a casestudy for decentralized parallel stochastic gradient de-scent.Advances in Neural Information Processing Systems30, 8:5331–5341, 2018.

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