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 Diffie-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 Diffie-Hellman Key Exchange method for privacy protection.

Experimental Setup and Evaluation Results

Experimental Datasets

Table 3: Summary of datasets

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Compounds</th>
<th>Average of Nodes</th>
<th>Average of Edges</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESQL</td>
<td>1128</td>
<td>13.29</td>
<td>40.65</td>
</tr>
<tr>
<td>FreeSolv</td>
<td>642</td>
<td>8.72</td>
<td>25.60</td>
</tr>
<tr>
<td>Lipophilicity</td>
<td>4200</td>
<td>27.04</td>
<td>86.04</td>
</tr>
<tr>
<td>mERG</td>
<td>10572</td>
<td>29.39</td>
<td>94.99</td>
</tr>
<tr>
<td>BACE</td>
<td>1513</td>
<td>34.00</td>
<td>36.89</td>
</tr>
<tr>
<td>BBBP</td>
<td>2019</td>
<td>24.03</td>
<td>25.94</td>
</tr>
<tr>
<td>SIDER</td>
<td>1427</td>
<td>33.64</td>
<td>35.36</td>
</tr>
<tr>
<td>ClinTox</td>
<td>1478</td>
<td>26.13</td>
<td>27.86</td>
</tr>
<tr>
<td>Tox21</td>
<td>7831</td>
<td>18.51</td>
<td>25.94</td>
</tr>
</tbody>
</table>

- D-FedGNN can achieve similar performance 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
