MLDA: A multi-level k-degree anonymity scheme on directed social network graphs

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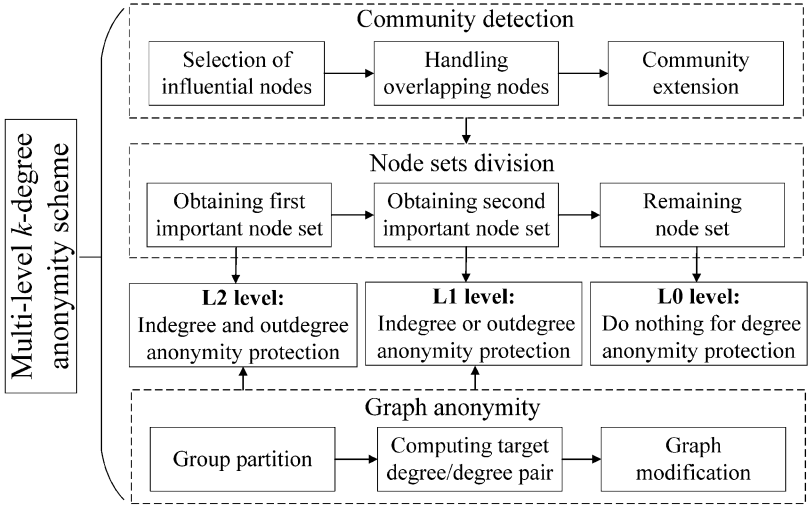
Problems & Ideas

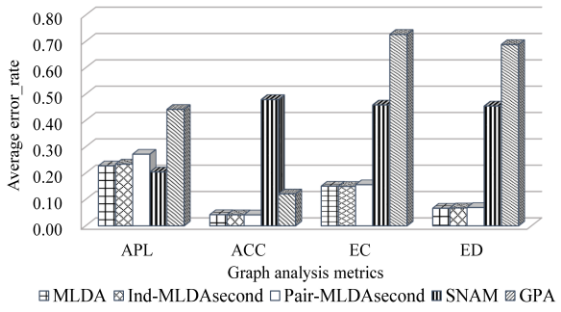
- Problems of privacy-preserving graph publishing scheme in the social networks
  - The protection of directed graphs is less concerned than that of undirected graphs.
  - The protection of graph structure is often ignored while achieving the protection of nodes' identities.
  - The same protection is performed for different users, which doesn't meet the different privacy requirements of users.
- Ideas: A multi-level k-degree anonymity (MLDA) scheme is proposed to achieve different privacy requirements of users, and a new graph anonymity method is presented to protect nodes' identities and the community structure of the original graph while ensuring maximum utility of the anonymized graph.



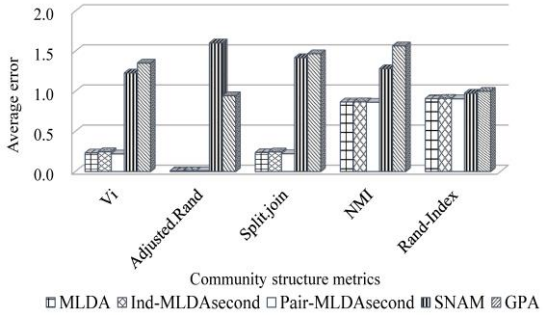
The flowchart of our scheme, where community detection is used to protect graph structure, node sets division is used to achieve different k-degree anonymity protection of users, and graph anonymity is used to obtain the anonymized graph.

Main Contributions

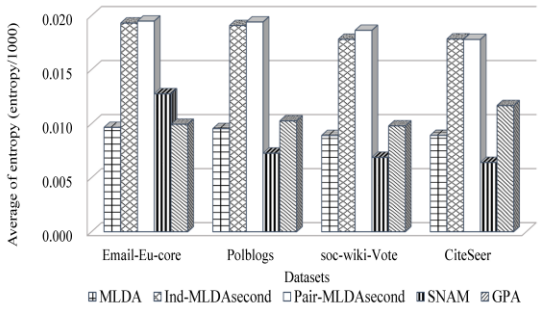
- Contributions
  - The proposed multi-level k-degree anonymity scheme (MLDA) performs different k-degree anonymity protections for different node sets, which achieves the personalized protection of users in the original graph.
  - The newly proposed graph anonymity method achieves the protection of nodes' identities and graph structure simultaneously.
  - A new edge cost criterion is proposed to reasonably select edges to be modified, which ensures the invariance of the community structure as much as possible and maximizes the utility of the anonymized graph.



1) Average *Error_rate* of graph analysis metrics



2) Average *rate* of community structure metrics



3) Average entropy of privacy metrics

The proposed scheme is evaluated by information loss metrics (including graph analysis metrics and community structure metrics) and privacy metrics (including entropy metric). The results of information loss metrics show that the proposed MLDA scheme greatly improves the utility of the anonymized graph. The results of privacy metrics show that the new graph anonymity method has better privacy compared with the compared methods.