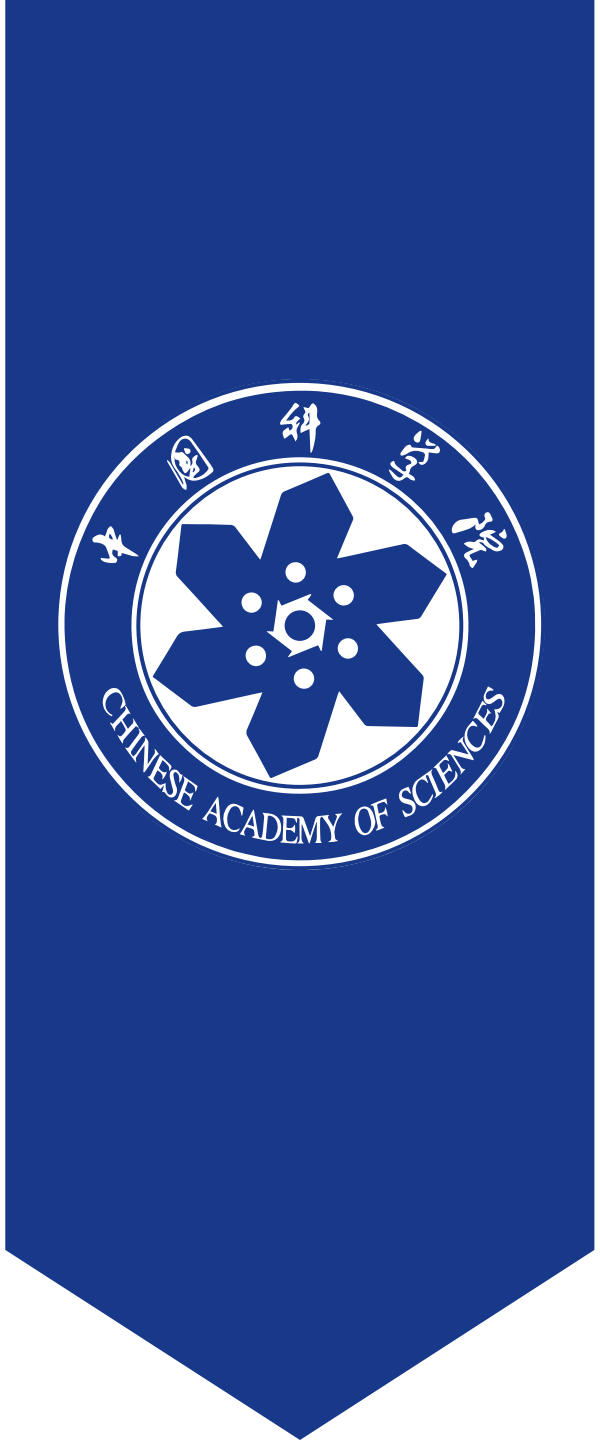

中国科学院上海微系统与信息技术研究所
Shanghai Institute of Microsystem and Information Technology Chinese Academy of Sciences

Trust Evaluation with Deep Learning in Online Social Networks: A State-of-the-art Review

Oral Presentation For

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Zhiqi Li

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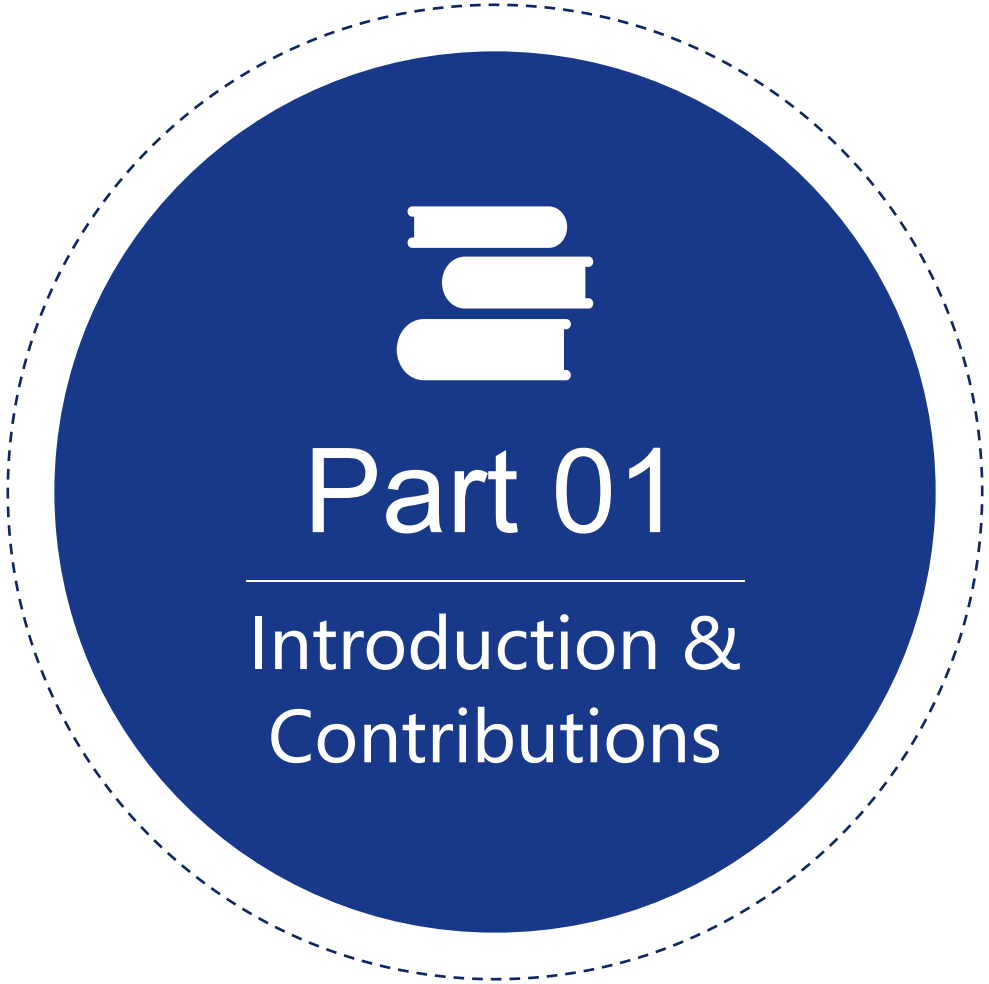
Contents



Part 01

Introduction & Contributions

Introduction

Trust Evaluation in OSNs

In the realm of online social networks (OSNs), it has become increasingly crucial to analyze user behavior, establish trustworthy relationships to mitigate social risks, enhance security, and safeguard privacy.

Trust evaluation is widely acknowledged as an effective approach for detecting internal attacks and identifying compromised nodes, and deep learning technology can significantly enhance its performance.

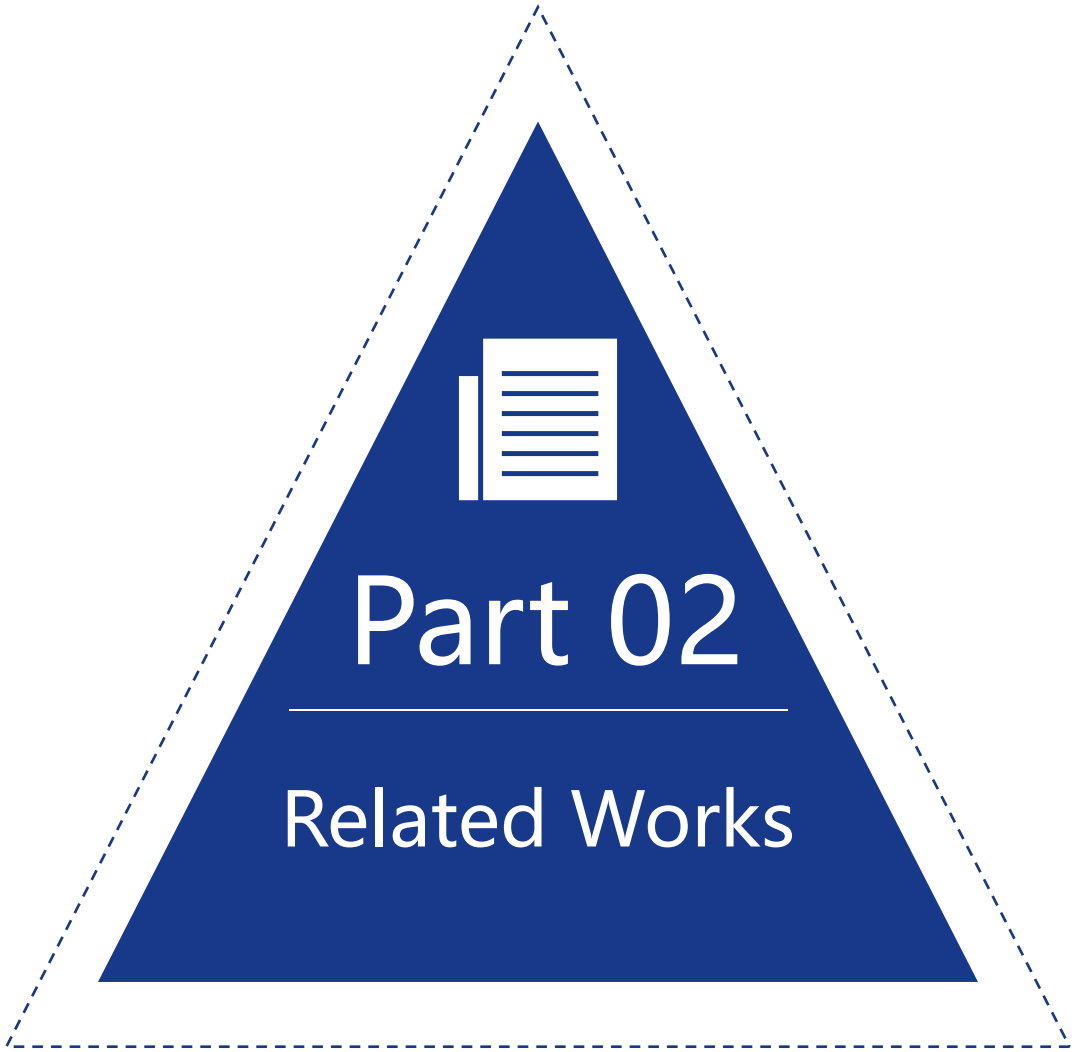
Contributions

1. Conducting a thorough analysis and comparison of advanced works related to trust evaluation using deep learning techniques in OSNs.

2. Finding that the GNN-based schemes encounter some formidable challenge of exponentially increasing computational complexity as network size expands.

3. Summarizing some prevalent challenges and open issues while proposing optimization strategies to address them.

4. Putting forth a range of suggested future research directions.


Part 02
Related Works

Related Works

Graph-based Deep Learning Methods

Graph-based methods in deep learning refer to techniques that leverage graph structures (nodes and edges) to model and analyze data, such as GNN.

Other Deep Learning Methods

Other deep learning methods, such as CNN and RNN.

Related Works with Graph-based Deep Learning Methods

Scheme	DE	IE	Trust	Rep.	Loc.	Glo.	Dataset	Result	Advantage	Disadvantage
TrustGNN *(C. Hou et al., 2023)*	√	√	√	×	√	√	Advogato, PGP, Ciao, Epinions	F1 = 74.4%, 87.2%, 72.8%, and 81.8%; MAE = 0.081, 0.083, 0.050, and 0.032.	Compared to other benchmarks, it exhibits superior accuracy, minimal errors, and low time complexity.	It is limited to static networks, and its modeling and computation processes are singular.
DCAT *(S. Ghafari et al., 2019)*	√	√	√	×	√	√	Ciao, Epinions	MAE = 0.36 and 0.4.	Strong context-awareness ability.	Weak ability to dynamically capture trust relationships.
CHEN *(X. Chen et al., 2019)*	√	√	√	×	×	√	Twitter Dataset	A = 96%.	High accuracy by analyzing the overlapping area of positive and negative feature distributions.	Weak context-awareness ability for different scenarios and time.

Huo, C., He, D., Liang, C., Jin, D., Qiu, T., Wu, L.: TrustGNN: Graph neural network-based trust evaluation via learnable propagative and composable nature. IEEE Transac-tions on Neural Networks and Learning Systems, 1–13 (2023)

Ghafari, S. M., Joshi, A., Beheshti, A., Paris, C., Yakhchi, S., Orgun, M.: DCAT: A deep context-aware trust prediction approach for online social networks. In: Proceed-ings of the 17th International Conference on Advances in Mobile Computing & Multi-media, pp. 20–27, ACM (2019)

Chen, X., Yuan, Y., Lu, L., Yang, J.: A multidimensional trust evaluation framework for online social networks based on machine learning. IEEE Access 7, 175499–175513 (2019)

Related Works with Graph-based Deep Learning Methods

Scheme	DE	IE	Trust	Rep.	Loc.	Glo.	Dataset	Result	Advantage	Disadvantage
NeuralWalk *(G. Liu et al., 2019)*	-	-	√	×	√	√	Advogato, PGP	F1 = 74.6% and 91.6%.	It can accurately predict unknown trust relationships in an inductive manner.	High time cost and computational consumption.
iSim *(X. Gao et al., 2021)*	-	-	√	×	√	×	Advotago, RobotNet	MAE = 0.1473 and 0.1300.	Low time complexity and strong context awareness-ability.	Poor robustness and generalization performance.
Medley *(W. Lin et al., 2021)*	×	√	√	×	√	×	Bitcoin-Alpha	A = 73.3%	Obtaining time features and using attention mechanism to assign weights.	High energy consumption and time cost.
GATrust *(N. Jiang et al., 2023)*	√	√	√	-	√	√	Advogato, PGP	F1 = 0.773 and 0.913, MAE = 0.076 and 0.079	Improving the social trust evaluation performance of users and predict trust.	Facing challenges related to the spatial and temporal dependencies.

Liu, G., Li, C., Yang, Q.: Neuralwalk: Trust assessment in online social networks with neural networks. In: Proceedings of the IEEE Conference on Computer Communica-tions, pp. 1999–2007, IEEE, Paris, France (2019)

Gao, X., Xu, W., Liao, M., Chen, G.: Trust prediction for online social networks with integrated time-aware similarity. ACM Transactions on Knowledge Discovery from Da-ta 15, 1–30 (2021)

Lin, W., Li, B.: Medley: Predicting social trust in time-varying online social networks. In: Proceedings of the IEEE Conference on Computer Communications, pp. 1–10, IEEE, Vancouver, BC, Canada (2021)

Jiang, N., Jie, W., Li, J., Liu, X., Jin, D.: GATrust: A multi-aspect graph attention net-work model for trust assessment in OSNs. IEEE Transactions on Knowledge and Data Engineering 35(6), 5885–5878 (2023)

Related Works with Others Deep Learning Methods

- M. Ghavipour et al. proposed DLATrust *(M. Ghavipour et al., 2018)*, aimed to identify reliable paths, and the trust network was treated as a static graph. However, the trust weights often change dynamically over time, prompting researchers to introduce a dynamic trust propagation algorithm called DyTrust *(M. Ghavipour et al., 2018)*.

- Q. Wang et al., AtNE-Trust, was capable of capturing high-quality user embed-dings and making accurate trust predictions *(Q. Wang et al., 2020)*. Nevertheless, most trust prediction methods tend to focus on specific aspects of trust, lacking comprehensive research on the development of user trust.They introduced C-DeepTrust to fill this gap *(Q. Wang et al., 2020)*.

Ghavipour, M., Meybodi, M. R.: Trust propagation algorithm based on learning automata for inferring local trust in online social networks. Knowledge-Based Systems 143, 307–316 (2018)

Ghavipour, M., Meybodi, M. R.: A dynamic algorithm for stochastic trust propagation in online social networks: Learning automata approach. Computer Communications 123, 11–23 (2018)

Wang, Q., Zhao, W., Yang, J., Wu, J., Zhou, C., Xing, Q.: Atne-trust: Attributed trust network embedding for trust prediction in online social networks. In Proceedings of the 2020 IEEE International Conference on Data Mining (ICDM), pp. 601–610, IEEE (2020)

Wang, Q., Zhao, W., Yang, J., Wu, J., Xue, S., Xing, Q., Philip, S. Y.: C-DeepTrust: A context-aware deep trust prediction model in online social networks. IEEE Transactions on Neural Networks and Learning Systems 34(6), 2767–2780 (2021)

Part 03

Challenges & Open Problems

Challenges & Open Problems

Challenges	Mitigation methods
1. The applicability of some trust management models has been restricted because of the diverse range of network structures.	1. The integration of adaptive mechanisms allows for flexible adjustment of parameters and strategies within the trust model.
2. Trust evaluation models based on GNN may encounter the problem of exponentially increasing computational complexity, especially as the network size grows.	2. The random sampling techniques. can reduce the computational load, but may result in information loss.

Challenges & Open Problems

Challenges	Mitigation methods
3. The dependence of trust evaluation on historical data is emphasized. However, in large-scale social networks, interactions between nodes are often sparse.	3. Trust propagation algorithms and active learning strategies.
4. The unequal distribution of samples among various classes or labels within a dataset is termed class imbalance. The performance is adversely affected.	4. The dataset balancing techniques.

Part 04

Research Directions

Research Directions

Trust Evaluation Based on Ensemble Learning with DNN in OSNs

Ensemble Learning (EL) is a powerful AI technique that combines multiple machine learning approaches to obtain the best possible solution. However, it is not without its drawbacks, which include long training hours and high computational overhead.

A DNN-based selector could be trained to select a suitable set of classifiers. This DNN-based selector efficiently determines which ML method classifiers are appropriate for the specific problem at hand. This pre-screening process reduces training and computation overhead.

Research Directions

Cross-origin Trust Evaluation Based on Deep Learning with a Hyperparameter Auto Optimizer (HAO) in OSNs

By incorporating a HAO into these evaluation systems, researchers could enable the automatic selection of optimal detection sub-systems and hyperparameter configurations.

The system is highly adaptable and can flexibly respond to the changing social network environment.

Acknowledgment

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Thanks!

Q & A