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Building trust networks in the absence of trust relations

Key words: Trust network; Sparse learning; Homophily effect; Interaction behaviors

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Motivation

- Trust is a complex and abstract concept. It is difficult to identify the inducing factors that build trust networks.
- To analyze these inducing factors, the simplest and best way is to observe real-world data about trust relations from social networks.
- In view of user behaviors, we divide the inducing factors of trust into interaction behaviors and the homophily effect.

Main idea

- Low-rank matrix tri-factorization seeks a 'factor model' for representation using a low-rank approximation.
- In our study, since we assume that a trust network is not available, interaction behaviors are modeled in trust prediction by capturing the correlation between positive interactions and trust relations.
- Homophily in social networks supports that users with higher similarity are more likely to establish trust relations than those with lower similarity.

Method

- The matrix factorization seeks a low-rank representation \mathbf{U} and \mathbf{H} via solving the following optimization problem:

$$\min_{\mathbf{U}, \mathbf{H}} \|\mathbf{X} - \mathbf{U}\mathbf{H}\mathbf{U}^T\|_{\text{F}}^2,$$

- To avoid overfitting, we add a smoothness regularization on \mathbf{U} and \mathbf{H} , and non-negative constraints are always applied to \mathbf{U} and \mathbf{H} . We have

$$\min_{\mathbf{U}, \mathbf{H}} \|\mathbf{X} - \mathbf{U}\mathbf{H}\mathbf{U}^T\|_{\text{F}}^2 + \alpha\|\mathbf{H}\|_{\text{F}}^2 + \beta\|\mathbf{U}\|_{\text{F}}^2$$

$$\text{s.t.}, \mathbf{U} \geq 0, \mathbf{H} \geq 0,$$

- Modeling interaction behaviors

$$\min_{\mathbf{U}, \mathbf{H}} \|\mathbf{W} \odot (\mathbf{X} - \mathbf{U}\mathbf{H}\mathbf{U}^T)\|_{\text{F}}^2 + \alpha\|\mathbf{H}\|_{\text{F}}^2 + \beta\|\mathbf{U}\|_{\text{F}}^2$$

$$\text{s.t. } \mathbf{U} \geq 0, \mathbf{H} \geq 0.$$

- Modeling homophily effect

$$\min \sum_{i=1}^n \sum_{j=1}^n \zeta(i, j) \|\mathbf{U}(i, :) - \mathbf{U}(j, :)\|_{\text{F}}^2.$$

Major results

- The performances of our proposed framework bTrust on Epinions and Ciao

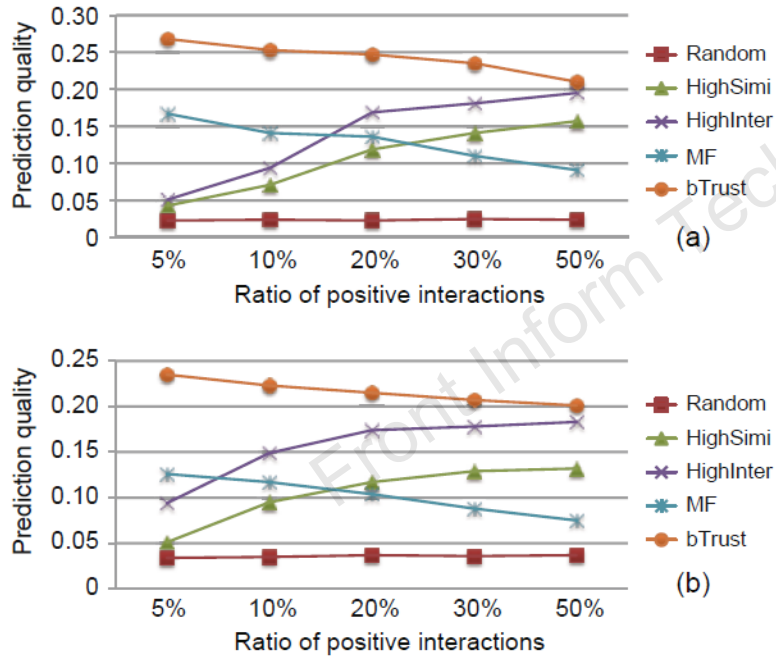


Fig. 2 Performance comparison on Epinions (a) and Ciao (b)

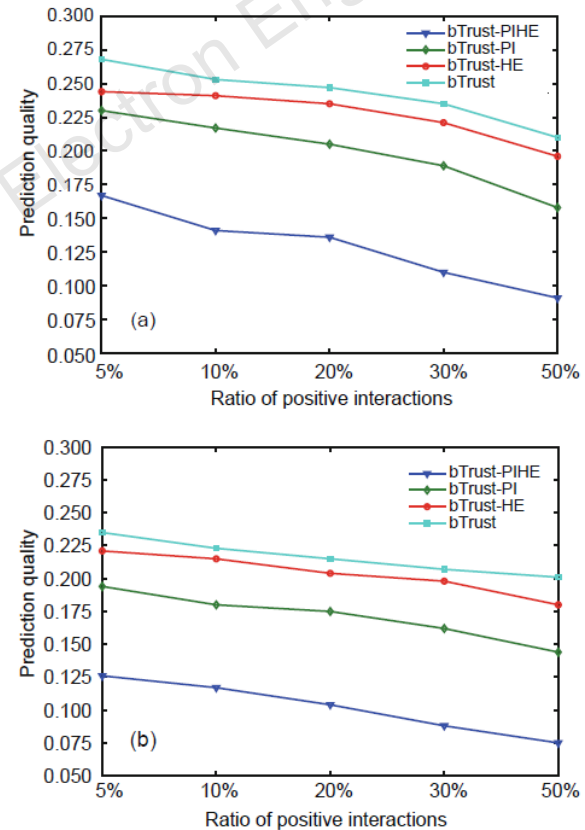


Fig. 3 Performance comparison on Epinions (a) and Ciao (b)

Conclusions

- We investigated whether we can build a trust network indirectly by studying the problem of predicting trust relations from interaction behaviors and the homophily effect.
- We proposed a novel framework, bTrust, to predict trust relations and build a trust network by incorporating interaction behaviors and modeling the homophily effect.
- Experiments on real-world datasets showed that bTrust can accurately predict trust relations. Further experiments were conducted to understand the importance of interaction behaviors and homophily effect in trust prediction.