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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 ***U*** and ***H*** via solving the following optimization problem:

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

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

$$\min_{\boldsymbol{U},\boldsymbol{H}} \ \|\boldsymbol{X}-\boldsymbol{U}\boldsymbol{H}\boldsymbol{U}^{\mathrm{T}}\|_{\mathrm{F}}^2+\alpha\|\boldsymbol{H}\|_{\mathrm{F}}^2+\beta\|\boldsymbol{U}\|_{\mathrm{F}}^2$$
$$\text{s.t.,}\ \boldsymbol{U}\geq 0,\ \boldsymbol{H}\geq 0,$$

- Modeling interaction behaviors

$$\min_{\boldsymbol{U},\boldsymbol{H}} \ \|\boldsymbol{W}\odot(\boldsymbol{X}-\boldsymbol{U}\boldsymbol{H}\boldsymbol{U}^{\mathrm{T}})\|_{\mathrm{F}}^2+\alpha\|\boldsymbol{H}\|_{\mathrm{F}}^2+\beta\|\boldsymbol{U}\|_{\mathrm{F}}^2$$
$$\text{s.t.}\ \ \boldsymbol{U}\geq 0,\ \boldsymbol{H}\geq 0.$$

- Modeling homophily effect

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

Major results

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

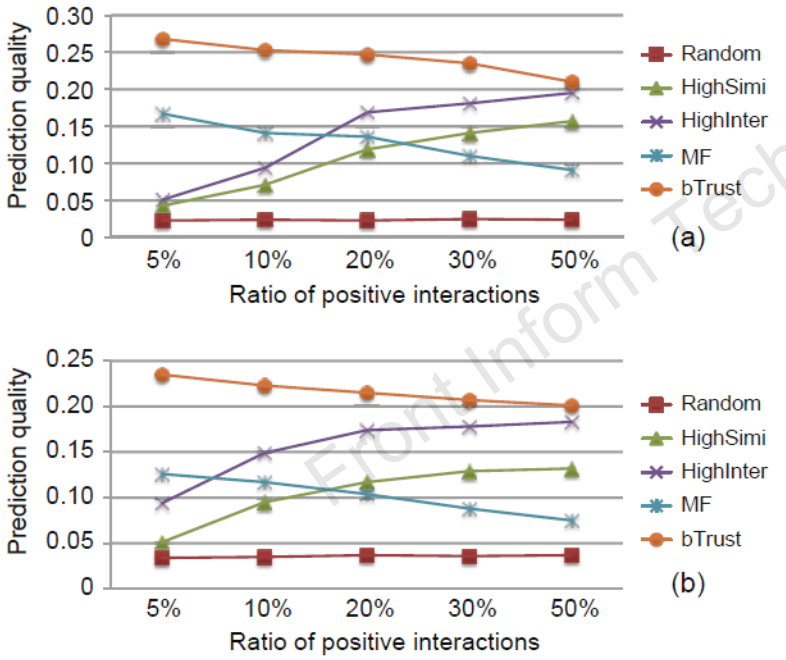

Fig. 2 Performance comparison on Epinions (a) and Ciao (b)

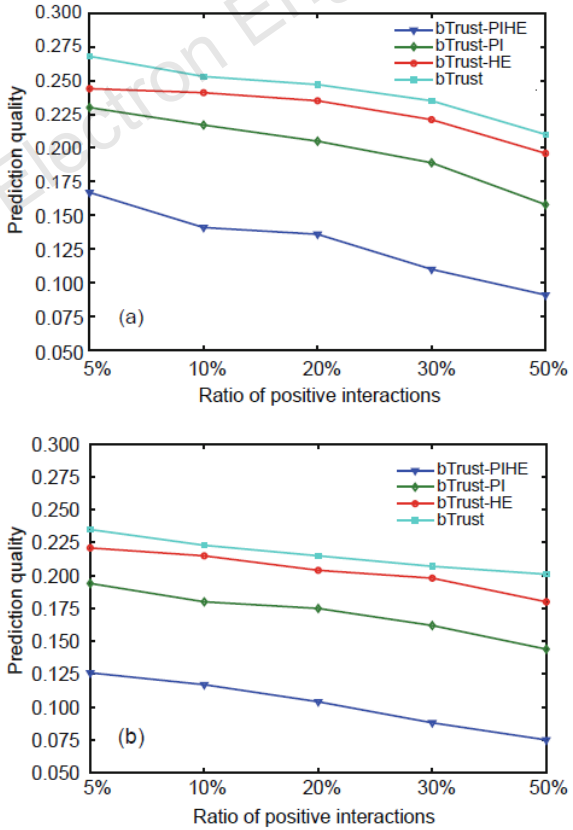

Fig. 3 Performance comparison on Epinions (a) and Ciao (b)

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.