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A Trust Model for Effective Selection of Sellers

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Abstract: The existence of "Online Water Army" makes the mode of depending on regarding customer comments as the criteria of judging sellers become less and less reliable in E-commerce. Based on this fact, from the buyer' s social network, authors set up a trust model for effective selection of sellers based on the social network and take the advantage of the node of social network on the evaluation feedback result of the seller to assist the customer to make a decision. The model, according to the theory of structural holes of social relations, evaluates the weight of every recommended route formed in the social network and finally gets a trust value which shows the seller' s reliability. In this paper, finally, authors take an example and show how to calculate the trust value.

Key words: Trust, e-commerce, social network, model, seller

INTRODUCTION

As the E-commerce is becoming more and more popular today, on-line shopping gradually becomes a part of people's life. However, not like the traditional shopping environment, the e-commerce features anonymity, randomness and dynamic, strange sellers and customers have no trust basis like it exists in the traditional shopping environment during the process of business. Moreover, under the E-commerce environment it actually exists a lot of deceitful identification, fake information and conspiracy cheat and online water army. So how to help the customer to recognize and select a reliable excellent seller becomes the key bottleneck of restricting the further development of e-commerce.

Regarding the mutual trust problems of both parties of business under the environment of e-commerce, many domestic and overseas scholars make relative studies. Zhang *et al*. (2007) made a lot of work on the trust computing of e-commerce, such as the trust computing model based on familiarity, by which, the customer evaluates the seller according to the familiarity. The degree of familiarity depends on the prior experience, repeated exposure, level of processing and forgetting rate. Before the deal between the customer and a new seller it needs to take advantage of the familiarity degree between him and some sellers who are similar to the seller himself or herself to calculate the initial familiarity on the new seller. And based on it it will be updated with the continuous processing. It is difficult to define the similarity between sellers which will influence the initial familiarity for every customer to know every seller. And if the customer doesn't take advantage the other customers' experiences in the system for the evaluation on the seller it will result in a very paranoid result easily. There are also many people who focus on the studies based on the trust network but the setting-up rules of network mainly are based on the reputation and scoring which can deal with a part of fake information but not advocate the potential social relationship and lack of effective incentive mechanism to promote people to comment the behavior of the seller and it can not guarantee that all these comments are subjective and correct, e.g. there are a lot of network ghost writer which will influence the trust based on the reputation and the accuracy of network. Obviously, there are some people who considered this problem and made some relative studies, such as the measure mechanism on the phenomenon of improper scoring under e-commerce from (Zhang and Cohen, 2006; Kinateder and Rothermel, 2003; Wang *et al*., 2012). In the paper, according to the reasons of improper scoring it includes two levers: Pubic-private, global-local. It puts forward a individual method and gets certain effect.

Based on the processing of every customer and seller in e-commerce it introduce a relationship, namely, friendship, transmission mechanism of the trust relationship between friends make up the trust network (Josang and Ismail, 2002; Josang *et al*., 2006; Josang and Bhuiyan, 2008). It systemically puts forward an analyzing calculating mechanism TNASL for the reliable network trust transfer characteristics, transfer methods and network optimization. This mechanism can well describe and resolve the trust transfer characteristics of trust network. So, based on this, Gan *et al*. (2012) put forward its reliable network construction and optimization plan, in the study it regards all customers who bought something

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from the same seller as friends node automatically and builds a trust network, so the new customer can use the trust network to get the assessed value for the customer.

Although the way of taking advantage of the trust network to assist the customer to evaluate the seller can get a relatively subjective, true and reliable evaluation, the friend relationship under e-commerce is very difficult to define, such as the establishment method stated it neglects that the seller would get the support from the water army. In the paper, according to the Chinese social life experiences, from everyone's true social relationship it puts forward a trust model based on the social relationship. On the second part of the paper it briefly introduces several basic theories of social relationship and then puts forward a seller's trust model based on social relationship. On the third part it specifically introduces the model and the recommended algorithm of the mode. On the fourth part, from an example it explains the computation process of the model. The fifth part summarizes and puts forward what to do for next stage.

RELATED WORK

Early in 1969, Mitchell defines the social relationship online as a group of unique relationship among a certain group of persons (Mitchell, 1969). Especially in China, social network is also called interpersonal relationship network. Changhuo Bao says, interpersonal network is a relationship network in which people can communicate information with each other for achieving their specific purposes (Bao *et al*., 2003). The social relationship includes blond relative relationship, friendship, colleague relationship and teacher-student relationship and etc. Marx's theory of social relations tells us that everybody can not escape the relationship and live alone, because it can not be transferred by human' s will (Zhou, 2007). Therefore, when we hesitate to face the choices and face the strange things and issues, we often have to ask for the suggestions from our surrounding people to get some information to support us which is the benefit from the interpersonal network.

In 1970s, week-relationship advantage theory, put forward by Granovetter Mark, initially introduced the concept of relationship tense in the mode of "strong relationship- week relationship" which made by himself. Based on this concept, we know the organization and people who have strong relationship have much stronger blond relationship, love and beneficial relationship, closer mutual communication, enough communication between new schools and mutual trust between members. Moreover, the individual who has strong relationship has single knowledge since every aspect is very similar. The week-relationship normally is used to connect the different group of people, the information of this group has higher freshness more than the people who have strong relationship which might be the most needed information for the people who have strong relationship (Wang and Fan, 2007; Qin and Zhou, 2006).

In 1992, a theory of the Structural Holes, put forward by Ronald Burt, from the fixed quantity, introduced a measure of value for relationship, namely, "structural holes". The more structural holes it has, the more richer the social resources it has for the node. In the paper it shows that the more numbers of the tree holes it has, the more obvious the advantage of competitiveness it has. The theory of "Division of 6 degrees" proves the existence of social relationship and its function on information transfer. The theory of "Strong relationship-weak relationship" qualitatively analyzes how important the relationship for the organization and it points out that the existence of weak-relationship will bring a positive effect to enrich and assist the variety of individual knowledge among strong-relationship (Burt, 1992, 2001).

TRUST MODEL FOR EFFECTIVE

Selection of sellers based on:

Social relationship: The trust model for effective selection of sellers based on social relationship, beginning from the customer' s social network, unifies the friend' s node in the network to recommend the seller and that the customer consults the suggestions from friends in network. According to the calculating method of the model it gets feedback value from every customer and the customer uses this feedback value to judge whether conduct the business. On the calculating method, please refer to the algorithm rules on how the trust transfers in the internet which was put forward by Josang. Meanwhile it introduces the numbers of structural holes as the weight of transferring the route trust value, to enable every recommended value of every node not only to be related with trust degree from the precursor node but also the value of the node itself. For better analysis, please refer to the following fundamental definitions.

Definition 1 friend: The social relationship can be divided into teacher-student relationship, relative relationship, colleague relationship, friendship and etc. In the paper, the author defines all positive relationships which related to himself or herself as friendship and all partners are all friends F for himself or herself.

Definition 2 the transfer of friendship: The friendship can be transferred in the way of A—> B, B—>C ==> A—>C but the trust degree between friends can not be transferred it will have consumption during the process.

Definition 3 social network: According to the friendship of Definition 1, we can construct a social network for every seller in the figure. Every node in the figure expects the customer' s node is direct or indirect friend of the customer.

In the paper, the trust computing model of the seller's gets the assessed trust value for every potential seller:

$$Supt(P) = \sum_{i=1}^{n} w_i * (T_{N_k}^{F_i} \otimes Supt(N_k)) \quad (1)$$

Seen from the above formation, W_i is the weight of this route, F_i is the No.i approximal point of n, $N_k$is the subsequent node F_i of this route. $\otimes$ is defined in [2], thetrust value T^{fi}_{Nk} is a abstract tetrad (b,d,u,a), among which, b means the complete trust degree for N_k from F_i , d means the complete trustless degree for N_k from F_i , u means the uncertain degree for N_k from F_i, a means the possibility of transferring u to be b and b+d+u = 1.

Achievement of the weight value of model: Suppose there is a person named P, to get his partly social relationship as follows:

Then, we can get an adjacent matrix of the social relationship for P as follows:

$$\begin{bmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \end{bmatrix}$$

Obviously, from the adjacent matrix, two nodes have no structural holes, we just need to see whether the opposite position is 0 or not, if it is 0 it means it exists structural holes.

Then, if P conducts business with the seller S, from every route from P to S, the numbers of structural holes which separately exist are: $h_1, h_2, \ldots, h_n$, then the weight of No.i is:

$$W_i = \frac{h_i + 1}{n + \sum_1^n h_i} \quad (2)$$

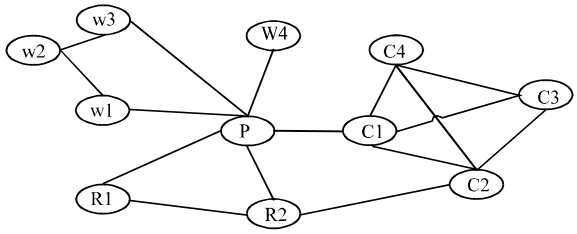

Fig. 1: Chart of social relationship

The route I is $V_0 \rightarrow V_1 \rightarrow V_2 \ldots \rightarrow V_{k-1} \rightarrow V_k$ and the definition of hi is as follows:

$$h_i = \sum_{i=0}^{k-2} Count(\sim \vec{V}_i \,\&\, \vec{V}_i \wedge \vec{V}_{i+1}) - \sum_{i=0}^{k-2} Count(\vec{V}_i \,\&\, \vec{V}_{i+1}) - k + 1$$

Seen from the above formation, V_i and V_k are initial nodes and separately nodes for the customer P and the seller S, Count operation is to calculate the umber of the component I of the vector quantity. V_i is the node V_i' s corresponding row vector in the adjacent matrix. ~ and ^ are, respectively vector complementation and, XOR.

Transfer computing of the trust: The transfer link of the trust A→B→C, is $T^A_B = (b^A_B, d^A_B, u^A_B, a^A_B)$, separately,the trust for B from A is , the trust for C from B is,through B' is $T^B_C = (b^B_C, d^B_C, u^B_C, a^B_C)$, transfer, finally, the reference value of trust for A is as follows:

$$T_C^{A:B} = T_B^A \otimes T_C^B = \begin{cases} b_C^{A:B} = b_B^A * b_C^B \\ d_C^{A:B} = b_B^A * d_C^B \\ u_C^{A:B} = d_B^A + u_B^A + b_B^A * u_C^B \\ a_C^{A:B} = a_C^B \end{cases}$$

In the practical computing, the calculating result of every seller can be used as the j udge for the customer to choose, for multiple comments of the sellers, the results from the model can be directly used as the basis of choice for the customer, because the biggest assessed value of the seller could be regarded as that the seller who is the most trust and reliable one.

EXPERIMENTS

Suppose there is a trust network as follows: There is a given trust value chart as follows in Table 1.

The adjacent chart is showed as follows:

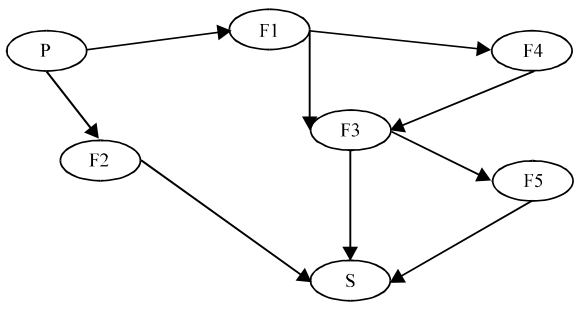

Fig. 2: Imitation of the computing network

Table 1: A given trust value

	P ->F1	P ->F2	F1->F4	F1->F3	F4-> F3	F3->F5	F2->S	F3->S	F5->S
b	0.6	0.8	0.5	0.8	0.4	0.5	0.7	0.7	0.4
d	0.2	0.1	0.3	0.1	0.3	0.1	0.2	0.1	0.5
u	0.2	0.1	0.2	0.1	0.3	0.4	0.1	0.2	0.1
	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

$$\begin{bmatrix} \# & P & F_1 & F_2 & F_3 & F_4 & F_5 & S \\ P & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\ F_1 & 1 & 0 & 0 & 1 & 1 & 0 & 0 \\ F_2 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ F_3 & 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ F_4 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ F_5 & 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ S & 0 & 0 & 1 & 1 & 0 & 1 & 0 \end{bmatrix}$$

From the above picture, through F1 and F2, P can get the trust evaluation for S from two main routes and can make the following calculation separately (supposing the value of a keeps the same during the operation):

$$Supt(F3) = 1/2\times(0.7,0.1,0.2,0.5)+1/2\times(0.5\times0.4, 0.5\times0.5,0.1+0.4+0.5\times0.1,0.5) = (0.45,0.175,0.375,0.5)$$

$$Supt(F4) = 1/1\times(0.4\times0.45, 0, 4\times0.175,0.3+0.3+ 0.4*0.375,0.5) = (0.14,0.07,0.738,0.5)$$

$$Supt(F1) = 2/3\times(0.5\times0.14,0.5\times0.07, 0.3+0.2+0.5\times0.738,0.5)+1/3\times(0.8\times0.45,0.8\times0.175, 0.1+0.1+0.8\times0.375,0.5) = (0.17,0.07,0.75,0.5)$$

$$Supt(F2) = (0.7,0.2,0.1,0.5)\ Supt(P) = 3/4\times(0.6+1/4\times(0.8\times0.17,0.8\times0.07,0.2+0.2+0.61+0.75\times0.1, 0.5) = (0.217,0.0715,0.7075,0.5)$$

Therefore, the calculation of the model is a process of recurrence, the reserve calculation of the subset could greatly simplify the calculation difficulty of the model and the calculating process of recursion can be easily realized by computer programming.

CONCLUSION

In the study, authors add the structural holes as weight impact factor in the trust transfer of traditional trust network, make the value of recommended information of every node different and makes the final recommended value can give consideration to the sparse degree of the whole network, the more sparse it is, the more structural holes it has and the more higher value of the recommended information it has. In the paper it says the more structural holes it has, the more positive the information it has but it doesn' t consider the possibility of the negative effect it may occur. In the future, authors should specifically analyze the influence of the existence of the structural holes on the network recommended information. In addition, the model doesn' t concern the feedback after every recommendation and it can not further update the network structure after the recommendation for every node which is the research direction of the future.

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