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(54) Title: SYSTEMS AND METHODS FOR CONDUCTING RELATIONSHIP DEPENDENT ONLINE TRANSACTIONS

(57) Abstract: Systems and methods for conducting online transactions based upon a scored relationship between the transacting users in accordance with embodiments of the invention are illustrated. In one embodiment, a relationship dependent transaction system includes a transaction server system including a processor and a memory, wherein the transaction server system obtains transaction request data identifying a source user and a target user, determines a transaction score based on the transaction request data for the source user and the target user by querying a reputation database, when the transaction score exceeds a threshold value, authorizes the requested transaction, and when the transaction score does not exceed the threshold value, declines the requested transaction.
SYSTEMS AND METHODS FOR CONDUCTING RELATIONSHIP DEPENDENT
ONLINE TRANSACTIONS

STATEMENT OF FEDERAL FUNDING
[0001] These inventions were made with government support under Grant No. FA9550-12-1-0411 awarded by the Department of Air Force. The government has certain rights in the inventions.

FIELD OF THE INVENTION
[0002] The present invention relates generally to online social networks and more specifically to transactions conducted via online social networks.

BACKGROUND OF THE INVENTION
[0003] An online social network is a service that allows members to post information and maintain relationships with other members of the online social network. A member of an online social network is usually represented using a user profile that includes information regarding the member and the relationships with other members of the online social network. Many online social networks are web-based and provide means for members to interact over the Internet, such as e-mail and instant messaging along with tools for posting member-generated content, such as text posts and images.

SUMMARY OF THE INVENTION
[0004] Systems and methods for conducting online transactions based upon a scored relationship between the transacting users in accordance with embodiments of the invention are illustrated. In one embodiment, a relationship dependent transaction system includes a transaction server system including a processor and a memory, wherein the transaction server system obtains transaction request data identifying a source user and a target user, determines a transaction score based on the transaction request data for the source user and the target user by querying a reputation database, when the transaction score exceeds a threshold value, authorizes the requested transaction, and when the transaction score does not exceed the threshold value, declines the requested transaction.
In another embodiment of the invention, the relationship dependent transaction system further includes a reputation server system including a processor and a memory, wherein the reputation server system obtains user data describing one or more users of an online social network, determines relationship data between the source user and the target user, where the source user and the target user are described in the user data, and generates transaction score data describing the relationship between the source user and the target user.

In an additional embodiment of the invention, the transaction server system further generates recommendation data when the transaction score does not exceed the threshold value, where the recommendation data concerns actions that could raise the transaction score.

In yet another additional embodiment of the invention, the recommendation data includes metadata describing an endorsement from a third user, where the third user has a relationship with the source user and the target user.

In still another additional embodiment of the invention, the transaction score is determined based on relationship data describing the relationship between the source user and a target user in an online social network.

In yet still another additional embodiment of the invention, the relationship between the source user and the target user is a direct relationship.

In yet another embodiment of the invention, the relationship data indicates negative interactions between the source user and the target user.

In still another embodiment of the invention, the relationship data describes mutual users that have relationships with both the source user and the target user.

In yet still another embodiment of the invention, the relationship data includes relationship age metadata describing the age of the relationship between the source user and the target user and the relationship score is based on the relationship age metadata.

In yet another additional embodiment of the invention, the relationship score is based on a degree of separation between the source user and the target user.
In still another additional embodiment of the invention, the degree of separation between the source user and the target user is calculated by selectively querying available social graphs from an online social network.

In yet still another additional embodiment of the invention, the available social graphs include a scored directed graph of relationships between users of the online social network.

In yet another embodiment of the invention, the source user is represented by a source user node in the scored directed graph, the target user is represented by a target user node in the scored directed graph, and the scored directed graph includes a set of nodes that can be directly reached from the source user node.

Still another embodiment of the invention includes a method for conducting relationship dependent transactions including obtaining transaction request data identifying a source user and a target user using a transaction server system including a processor and a memory, determining a transaction score based on the transaction request data for the source user and the target user using the transaction server system, when the transaction score exceeds a threshold value, authorizing the requested transaction using the transaction server system, and when the transaction score does not exceed the threshold value, declining the requested transaction using the transaction server system.

In yet another embodiment of the invention, the transaction score is determined by obtaining the transaction score from a reputation server system that obtains user data describing one or more users of an online social network, determines relationship data between the source user and the target user, where the source user and the target user are described in the user data, and generates transaction score data describing the relationship between the source user and the target user.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a network diagram showing a relationship dependent transaction system in accordance with an embodiment of the invention.

FIG. 2 is a flow chart illustrating a process for conducting a relationship dependent transaction based upon a transaction score determined with respect to
transacting users using a relationship dependent transaction system in accordance with an embodiment of the invention.

[0021] FIG. 3 is a flow chart illustrating a process for determining a transaction score with respect to transacting users in accordance with an embodiment of the invention.

[0022] FIG. 4 is a scored directed graph that conceptually illustrates a scored relationship based upon profile information maintained by one or more online social networks with respect to transacting users that directly interact via at least one online social network in accordance with an embodiment of the invention.

[0023] FIG. 5 illustrates a process for obtaining a relationship score based upon interactions between transacting users via one or more online social networks in accordance with an embodiment of the invention.

[0024] FIG. 6 is a scored directed graph that conceptually illustrates a scored network of connected profiles maintained by one or more online social networks along paths that connect transacting users in accordance with an embodiment of the invention.

[0025] FIG. 7 is a flow chart illustrating a process for scoring a network of connected profiles maintained by one or more online social networks along paths that connect transacting users in accordance with an embodiment of the invention.

[0026] FIGS. 8A and 8B illustrate incomplete graphs constructed based upon limited information provided by one or more online social networks concerning user profiles that are connected to form paths that connect the transacting users in accordance with an embodiment of the invention.

[0027] FIG. 9 is a flow chart illustrating a process for scoring affiliations between transacting users based upon profile information maintained by one or more online social networks in accordance with an embodiment of the invention.

[0028] FIG. 10 is a flow chart that conceptually illustrates a process for estimating an initial global reputation score with respect to a new user of a reputation dependent transaction system in accordance with an embodiment of the invention.

[0029] FIG. 11 conceptually illustrates a reputation server in accordance with an embodiment of the invention.
FIGS. 12A and 12B illustrate data stored within a database that can be retrieved to complete incomplete graphs of paths that connect transacting users in accordance with embodiments of the invention.

FIG. 13 conceptually illustrates a transaction server in accordance with an embodiment of the invention.

DETAILED DESCRIPTION

Turning now to the drawings, systems and methods for conducting online transactions based upon a scored relationship between the transacting users in accordance with embodiments of the invention are illustrated. When a transaction involves a commodity good, a purchaser is typically primarily concerned with the global reputation of a particular seller. For example, reviews concerning the sellers' customer service or on time delivery performance. When the manner in which a specific provider of a good or service interacts with a given purchaser is an important part of a transaction, a global reputation may not provide a reliable expectation of a specific individual's satisfaction with the outcome of the transaction. Transactions in which an individual purchaser's satisfaction is dependent upon the manner in which the given purchaser interacts with a specific seller can be described as relationship dependent transactions. Examples of relationship dependent transactions include (but are not limited to): finding a roommate; consulting with a physician or therapist; retaining an architect, landscape architect, or interior designer; hiring a babysitter; and ride-sharing.

In a number of embodiments, a relationship dependent transaction system facilitates online transactions between users by providing transaction scores determined based upon information concerning the transacting users maintained by one or more online social networks. The transaction scores can correspond to the likelihood that the transaction will succeed and/or the level of trust that does exist between the transacting parties in the context of the specific transaction (i.e. the trust between the parties may be different for another type of transaction). The transaction satisfaction scores or transaction scores are personalized in that they depend upon information specific to the transacting users. Were another user to initiate the same online transaction with the same vendor, a reputation dependent transaction system is likely to generate a different transaction score with respect to the online transaction. In several embodiments, the
relationship dependent transaction system utilizes the transaction score to determine whether to allow the online transaction to proceed and/or the manner in which to conduct the online transaction. For example, pricing and/or the need to purchase a warranty and/or insurance may be required as a condition of the online transaction by the relationship dependent transaction system. In a number of embodiments, the relationship dependent transaction system can also provide the transacting users with information concerning additional steps that can be taken to improve the ability of the relationship dependent transaction system to calculate a transaction score.

[0034] In several embodiments, the reputation dependent transaction system includes a reputation server system that generates transaction scores by constructing a scored graph of relationships that exist between the transacting users. A user that initiates a transaction can be referred to as the source user and the user with which the source user would like to conduct a transaction can be referred to as the target user. In many instances, the source and target user maintain user profiles that directly interact via an online social network (i.e. they are directly connected) and/or another communication mechanism such as (but not limited to) a messaging service, an email service, and/or any other online service that enables user interactions. In such instances, the process of scoring the relationship between the source and target users can involve (but is not limited to) scoring the similarity of the users' profiles (i.e. their affinity) and the number and quality of the interactions between the users. As is discussed further below, profile information and information concerning interactions can be drawn from a number of sources including (but not limited to) a plurality of online social networks. When the source and target users do not have a history of direct interactions via an online social network, a transaction score can be determined by scoring a network of relationships between the source and the target users. In many embodiments, scoring a network involves scoring the interactions and/or affinity of the network of interacting users that indirectly connect source and target users. In a number of embodiments, the reputation server system has an incomplete view of the network connecting the source and target user due to the partial view of the social graph(s) that may be exposed by the one or more online social networks on which the transacting users are active. In several embodiments, a reputation server system can
evaluate the partial view of the social graph to determine likely connections that may exist between profiles of users that interact directly with the source and target users. The reputation server system can then query the social graphs maintained by one or more online social networks to determine whether user pairs corresponding to likely connections actually interact. When users are found to interact, a previously unknown connection within the network of paths that exist between the source and target users is established. In many embodiments, the reputation server system accumulates relationship scores and network scores and can use the accumulated data concerning direct connections and/or sub-networks between users to identify additional connections that may exist within the network between a source user and a target user. These connections can then be added to the view of the network between the source and target users maintained by the reputation server system.

[0035] In a number of embodiments, the ability to generate personalized transaction scores enables a reputation server system to generate initial global reputation estimates. In a typical online transaction system such as an E-commerce website, a user that has conducted no (i.e. zero) or a small number of transactions has very little global reputation. By identifying individuals that are active within one or more online social networks that are known to be highly trustworthy, a reputation server system in accordance with many embodiments of the invention can utilize the interactions (or lack of interactions) with reputable users to construct a global reputation score for a user that has conducted very few transactions.

[0036] Relationship dependent transaction systems, processes for determining personalized transaction satisfaction scores, processes for conducting online transactions based upon personalized satisfaction scores, and processes for estimating global reputation for users with limited transaction history in accordance with embodiments of the invention are discussed further below.

Relationship Dependent Transaction Systems

[0037] A relationship dependent transaction system in accordance with an embodiment of the invention is illustrated in FIG. 1. The relationship dependent transaction system 10 includes a reputation server system 12 that maintains a
reputation database 14. The reputation server system 12 communicates via a network 16 with an online social networking service server system 18. The online social networking service server system 18 can include a database 20. In many embodiments, the database 20 includes information concerning interactions between users that maintain accounts within the online social network. The reputation server system 18 is also configured to communicate with an online transaction server system 22.

[0038] In many embodiments, users can utilize any of a variety of user devices 24 to communicate with the online transaction server system 22 via the network 16 to initiate an online transaction. In the illustrated embodiment, the user devices 24 are personal computers and mobile phones. As can readily be appreciated, any Internet connected (or otherwise network connected) device that can be utilized to conduct an online transaction via a native software application and/or a web browser application can be utilized to initiate a reputation dependent transaction in accordance with an embodiment of the invention including (but not limited to) personal computers, tablet computers, mobile phones, wearable computing devices, and/or connected consumer electronics devices such as (but not limited to) televisions, set top boxes, and/or game consoles. As part of the transaction, the users attempting to initiate the transaction can provide information identifying their user profiles within one or more online social networks. In several embodiments, the online transaction server system 22 provides the user identities to the reputation server system 12, which determines a transaction score based upon the user identities and provides the transaction score to the online transaction server system 22.

[0039] In a number of embodiments, the reputation server system 12 determines the transaction score by querying the reputation database 14 to obtain a previously generated transaction score. In certain embodiments, the reputation server system 12 determines the transaction score in real time. In several embodiments, the process of generating the transaction score involves querying one or more online social networks to determine whether the identified source and target users interact directly. In the event the source and target users interact directly, the profiles and/or the frequency and/or quality of interactions of the source and target users can be utilized to determine
the transaction score. In many instances, the online social networks will have no information concerning direct interactions between the source and target user. Where no information concerning direct interactions is available, the reputation server system can construct a view of a network of relationships between users that directly interact via one or more online social networking service and information concerning the networks of the users. A transaction score can then be determined based upon the source and target user profiles and the network that exists between the source and target users.

[0040] In many embodiments, an online social networking service server system 18 does not completely expose the social graph represented within its database(s) 20. Instead, the online social networking service server system 18 exposes partial views of the social graph via mechanisms including but not limited to Application Programming Interfaces (APIs). In several embodiments, a reputation server system 12 can evaluate a partial view of the social graph to determine likely connections that may exist between profiles of users that interact directly with the source and target users. The reputation server system 12 can then query the online social networking service server system 18 to obtain additional information concerning the social graph it maintains to build a more complete view of the network of relationships between users that directly interact via the online social network that connects the source and target users.

[0041] In a number of embodiments, the reputation server system 12 accumulates relationship scores and network scores in the reputation database 14 and can use the accumulated data concerning direct connections between users and sub-networks of users to identify additional connections that may exist within the network between a source user and a target user. These connections can then be added to the view of the network between the source and target users maintained in the reputation database 14 by the reputation server system 12. Over time, the reputation server system 12 can update relationship scores and the updated relationship scores can be utilized to update the stored network scores.

[0042] In many embodiments, the database maintained by the reputation server system is a distributed database. In several embodiments, the database maintains information concerning source and target user pairs that directly interact via one or more online social networking service and information concerning the networks of users.
related users that exist between source and target user pairs. As discussed below, the scale of the distributed database may grow to an extent that indexes can be maintained that identify all of the networks connecting source and target user pairs that include specific pairs of users that directly interact (i.e. directly connected users) and/or specific sub-networks of users. In this way, the indexes can be utilized to update the networks of specific source and target user pairs within a reputation database in response to the reputation server system obtaining additional information concerning a specific pair of directly connected users that are connected within the indexed networks.

Although specific relationship dependent transaction systems are described above with reference to FIG. 1, any of a variety of relationship dependent transaction systems can be utilized as appropriate to the requirements of specific applications including (but not limited to) systems in which the reputation server system and the transaction server system forms part of an online social networking service server system in accordance with an embodiment of the invention. The manner in which relationship dependent transaction systems can be utilized to conduct relationship dependent transactions in accordance with embodiments of the invention is discussed further below.

Conducting Relationship Dependent Transactions

A process for conducting a relationship dependent transaction based upon a transaction score determined with respect to users transacting via a relationship dependent transaction system in accordance with an embodiment of the invention is illustrated in FIG. 2. The process 200 includes obtaining (202) information concerning a transacting pair of source and target users (i.e. a (source, target) pair). In a number of embodiments, the (source, target) pair provides identifying information that can be utilized to identify user profile information maintained by each of the (source, target) pair on one or more online social networks. In several embodiments, the identifiers can be tokens provided by the online social network(s). In certain embodiments, the tokens are stored by the reputation dependent transaction system. In this way, users can identify themselves to the reputation dependent transaction system and the tokens associated
with the users' identities used to retrieve information about the users from one or more online social networks on a continuous basis.

[0045] The information retrieved concerning the (source, target) pair can then be used to determine (204) a transaction score or scores with respect to the initiated transaction. A determination (206) can then be made concerning whether to authorize the transaction. When the transaction score(s) satisfy a predetermined set of criterion, then the transaction is authorized (208) and can proceed. In several embodiments, the specific manner in which the online transaction is conducted may be influenced by the transaction score. Factors that can be influenced include (but are not limited to) pricing, insurance requirements, and/or warranty requirements. In other embodiments, any of a variety of other factors can also be considered. When the transaction score(s) fail to satisfy the predetermined set of criterion, then the transaction is declined (210).

[0046] In a number of embodiments, the reputation dependent transaction system can provide (212) recommendations concerning actions that can be taken by the target user to increase the (source, target) pair's transaction score. For example, the reputation dependent transaction system could recommend that the target seek an endorsement from a user that interacts directly with both the source and target users. A high quality interaction such as (but not limited to) requesting and obtaining a relevant endorsement from a mutual friend can significantly increase the (source, target) pair's transaction score. In other embodiments, any of a variety of recommendations can be made as appropriate to the requirements of specific applications including (but not limited to) recommending that one or both users provide additional profile information, connect to additional friends, and/or provide credentials enabling access to additional online social networking services from which interaction information involving the transacting users can be accessed.

[0047] Although specific processes for conducting relationship dependent transactions are described above with reference to FIG. 2, any of a variety of processes can be utilized to conduct relationship dependent transactions that involve obtaining transaction scores with respect to the (source, target) pair initiating the transaction and then modifying and/or declining the transaction based upon the obtained transaction.
score(s). A variety of processes for determining transaction scores in accordance with embodiments of the invention are described below.

Determining Transaction Scores

[0048] A variety of techniques can be utilized to determine transaction scores depending upon the nature of the relationship between the source and target users conducting a transaction, and the information concerning the users that is available via online social networks. In many embodiments, a distinction is drawn between users that interact directly via online social networks and users that do not interact directly via online social networks. In the former category, direct interactions between users provides a strong signal that can be utilized to estimate transaction satisfaction. The mere fact that two users interact is not necessarily indicative that a transaction between them will have a successfully outcome. In many instances, strong interactions such as (but not limited to) endorsements can provide a strong prediction of a successful transaction. By contrast, negative and/or infrequent interactions with a user (such as, but not limited to, "muting" reporting abuse, and/or negative votes) can be a strong indicator that a transaction is unlikely to be successful. In circumstances where users do not interact, information concerning the relationships between mutual friends (i.e. users that interact directly) within a social network can provide an indication of the likely outcome of a transaction. Where users share many mutual friends (i.e. users that interact with both the source user and the target user), then the high proportion of mutual friends can strongly indicate a likelihood of a successful transaction. Where users are more remotely connected, then relationships between connected users within the network between the source and target user pair and the number of paths through the network that connect the source and target user pair can be indicative of the outcome of a transaction.

[0049] A process for determining a transaction score with respect to transacting users in accordance with an embodiment of the invention is illustrated in FIG. 3. The process 300 includes obtaining (302) source and target profile data from one or more online social networks. In the illustrated embodiment, a determination (304) is made concerning whether the source and target users interact directly (i.e. are directly
connected) via one or more online social networks. In the event that the source and
target users interact directly, then the users’ profile information and interactions can be
used to score (306) the relationship. In a number of embodiments, different weights are
attributed to types of profile information and/or interactions in determining a relationship
score. The relationship score can be utilized as and/or can be utilized to determine
(308) a transaction score for the (source, target) pair.

[0050] When the (source, target) pair are not directly connected, then the process
300 involves identifying (310) connections and/or affiliations that exist between the
source and target users within the social graphs maintained by one or more social
networks. As indicated above, online social networking services may not provide a
complete view of the social graph maintained by the service. Therefore, the process of
identifying connections that exist within the network of users within the (source, target)
network can involve successively querying online social networking services to build a
more complete view of the network. In several embodiments, a more complete view of
the network of users within the (source, target) network is achieved by querying a
database maintained by the reputation dependent transaction system to retrieve
information concerning directly connected users. Processes for identifying connections
that exist between source and target users in accordance with various embodiments of
the invention are discussed below.

[0051] The (source, target) network can be scored (312) and the process 300 can
optionally involve the scoring of the affiliations between the (source, target) pair. The
term affiliation can be used to refer to associations with common named entities that are
referenced in the profiles of the (source, target) pair. Named entities such as employers
and/or educational institutions can have significant weight. As can readily be
appreciated, the proximity in time and/or space of the relationship to the named entity
may increase or decrease the importance of the affinity (e.g. working for the same large
company at different times may involve a limited affinity score, however, working in the
same group at the same time may involve a higher affinity score). Processes for
scoring (source, target) networks and affinity in accordance with various embodiments
of the invention are discussed further below. Once a (source, target) network is scored
and/or a (source, target) affinity score is determined, the score(s) can be utilized to determine at least one transaction score for the (source, target) pair.

Although specific processes for determining transaction scores are described above with respect to FIG. 3, any of a variety of processes can be utilized to determine transactions scores as appropriate to the requirements of specific applications including (but not limited to) processes that determine the transaction score using different techniques based upon the number of degrees of separation between the source and target users within the network of related users indicated to exist between the (source, target) pair based upon information obtained from online social networking service(s) in accordance with embodiments of the invention. Processes for determining relationship scores, network scores, and affinity scores in accordance with embodiments of the invention are discussed further below.

Determining Relationship Scores

A scored directional graph that conceptually illustrates a process of scoring a relationship between a source and a target user based upon profile information and information concerning interactions between the source and target user maintained by one or more online social networks in accordance with an embodiment of the invention is illustrated in FIG. 4. In the illustrated embodiment, a relationship score \( r(S,T) \) can be maintained between the source user (node S) and the target user (node T). In this way, the source users, target users, and associated relationship score can be calculated and/or maintained utilizing a variety of data structures, including graph databases.

Turning now to FIG. 5, a process for obtaining a relationship score based upon interactions between transacting users via one or more online social networks in accordance with embodiments of the invention is illustrated. The process 500 includes obtaining (502) source profile data and/or target profile data. In several embodiments, the source profile data and target profile data identify source node(s) and target node(s) within a graph database. If endorsement data is obtained (504), a relationship score can be assigned (506) based on the endorsement data. If endorsement is not obtained (504), a relationship score can be assigned (508) based on interaction data describing the interactions between the source user profile and the target user profile. Additionally,
it should be noted that when endorsement data is received (504), the relationship score can be assigned (i.e. calculated) based on the endorsement data and the interaction data as appropriate to the requirements of specific applications of embodiments of the invention.

[0055] Although specific processes for determining relationship scores are described above with reference to FIGS. 4 and 5, any of a variety of processes can be utilized to score a relationship between a source user and a target user based upon information maintained concerning the source and target users by an online social network as appropriate to the requirements of specific applications in accordance with an embodiment of the invention.

Scoring Networks

[0056] Processes for scoring network in accordance with various embodiments of the invention attempt to score a (source, target) network based upon the strength of the relationships that exist between pairs of users within the (source, target) network and/or the number of paths connecting the source and target users through the (source, target) network. In many embodiments, the greater the degree of separation between the source and target users within the (source, target) network the greater the influence that the number of paths through the network can have on the (source, target) network score. In several embodiments, the relationships between the source user and the source user's direct connections (i.e. users with which the source user directly interacts) can be weighted based upon the number of paths through the network to the target node that pass through each of the user's direct connections. In other embodiments, any of a variety of techniques can be utilized to score a (source, target) network including (but not limited to techniques) that utilize different processes that consider different aspects of the network depending upon the degree of separation between the source and target users within the network.

[0057] As observed above, the process of scoring a (source, target) network can be complicated in instances where online social networking services provide an incomplete view of the (source, target) network. In a number of embodiments, a more complete view of the network can be obtained by selectively querying the available social graphs
to identify direct connections between users in the set of users that interact with the source and users in the set of users that interact with the target.

[0058] A scored directed graph that conceptually illustrates a scored network of connected profiles maintained by one or more online social networks along paths that connect a source user and a target user in accordance with an embodiment of the invention is illustrated in FIG. 6. In the illustrated embodiments, the scored directed graph illustrates all users that are directly connected (i.e. one hop away from the source user), two degrees of separation (i.e. two hops away from the source user), and three degrees of separation (i.e. three hops). In addition, the directed graph illustrates all paths incorporating four or fewer hops from the source user node to the target user node. Although a scored network including three hops is shown in FIG. 6, a greater number of hops can be considered in the scoring of networks in accordance with many embodiments of the invention.

[0059] In the illustrated embodiment, nodes are classified into sets. Set A is a list of all of the nodes that can be directly reached from the source node. In the illustrated directed graph, the source node and the target node are not directly connected. Set B is a list of all of the nodes that can be reached from the source node with two hops. In the illustrated embodiment, the target node is in Set B. Set C is the set of nodes that can be reached from the source node with three hops. Set C also includes the target node.

[0060] A flow chart illustrating a process for scoring a network of connected profiles maintained by one or more online social networks along paths that connect transacting users in accordance with an embodiment of the invention is illustrated in FIG. 7. The process 700 includes obtaining (702) source profile data and/or target profile data. In several embodiments, the source profile data and target profile data identify source node(s) and target node(s) within a graph database. Nodes connected to the source nodes and/or target nodes are identified (704). If the identified nodes indicate (706) mutual relationships between the source node and target node (i.e. "mutual friends"), the relationship network can be scored (708) based on activity between the source node, target node, and/or the identified nodes. That is, the activity between the source node and the identified nodes, the target node and the identified nodes, and/or activity
between the source node and the target node can be utilized as appropriate to the requirements of specific applications of embodiments of the invention. If no "mutual friends" exist (706), paths can be determined (710) between the source node and the target node. The network can be scored (712) based on activity defined using the paths and nodes between the source node and the target node. Additionally, it should be noted that, when "mutual friends" exist (706), the score can be based on both the activity between the source node and the target node with the "mutual friends" in addition to activity between other common nodes defined by the determined (710) paths as appropriate to the requirements of specific applications of embodiments of the invention.

[0061] Although specific processes for scoring networks that exist between source and target users are described above with reference to FIGS. 6 and 7, any of a variety of processes can be utilized to score a network between a source user and a target user based upon information maintained concerning the source and target users by one or more online social networks as appropriate to the requirements of specific applications including (but not limited to) processes that modify the scoring process based upon the degree of separation between the source and target users within the network connecting the source and target users in accordance with an embodiment of the invention. Processes for scoring (source, target) networks in which incomplete information is available concerning the relationships that exist within the network in accordance with embodiments of the invention are discussed further below.

Scoring Incomplete Networks

[0062] FIGS. 8A and 8B illustrate incomplete graphs constructed based upon limited information provided by one or more online social networks concerning user profiles that are connected to form paths that connect the transacting users in accordance with an embodiment of the invention.

[0063] The directed graph shown in FIG. 8A assumes that an online social networking service exposes information concerning the users with which the source and target users directly interact. In the illustrated embodiment, the set S contains the users that directly interact with the source user and the set T contains the users that directly
interact with the target user. Where one or more users is present in both set S and T, the (source, target) pair enjoy one or more "mutual friends" and information concerning interactions with mutual friends can be utilized to determine a network score. In the event that no mutual friends exist, then a process can be utilized to determine whether any connections exist between the users in sets S and T. In several embodiments, information concerning the users in sets S and T such as (but not limited to) number of connections and/or level of activity within the online social network can be utilized to identify users that are likely to be connected. Queries can then be submitted to the online social network requesting information concerning the interactions of the interacting users. In a number of embodiments, a database is maintained by the relationship dependent transaction system of information concerning (source, target) pairs. Information concerning a (source, target) pairs that include a user from sets S and/or T can be utilized to identify direct connections between sets S and T and/or, as illustrated in FIG. 8B, users that are mutual friends of users in sets S and T. In other embodiments, stored data concerning networks that connect users in sets S and T can be utilized to insert sub-networks into (source, target) networks. In a number of embodiments, a partially complete graph can be scored using a process similar to the processes described above for scoring directed graphs that completely represent a (source, target) network. In other embodiments, any of a variety of scoring processes can be utilized including (but not limited to) processes that weigh factors such as (but not limited to) the age of (source, target) pair information on which links in a (source, target) network are based and/or confidence metrics indicative of the completeness of the (source, target) network.

[0064] Although specific processes are described above with reference to FIGS. 8A and 8B for obtaining more complete view of (source, target) networks, any of a variety of processes can be utilized to determine (source, target) network scores in the absence of a complete view of the (source, target) network as appropriate to the requirements of specific applications in accordance with embodiments of the invention.
Scoring Affiliations

A process for scoring affiliations between transacting users based upon profile information maintained by one or more online social networks in accordance with an embodiment of the invention is illustrated in FIG. 9. The process 900 includes obtaining (902) source profile data and target profile data. In several embodiments, the source profile data and target profile data identify source node(s) and target node(s) within a graph database. Common named entities are identified (904) and affiliation scores are determined (906). Common named entities can be identified based on the number, type, and/or characteristics of the common named entities as appropriate to the requirements of specific applications of embodiments of the invention. Named entities can include, but are not limited to, organizations, groups, businesses, geographical locations, products, and any other entity that a user can express an opinion via an online social network as appropriate to the requirements of specific applications of embodiments of the invention. In this way, common interests and/or relationships between the source node and the target node can be identified based on expressed interest in common subject matter.

Although specific processes for scoring affiliations that exist between source and target users are described above with reference to FIG. 9, any of a variety of processes can be utilized to score affiliations between a source user and a target user based upon information maintained concerning the source and target users by an online social network as appropriate to the requirements of specific applications in accordance with an embodiment of the invention.

Estimating Global Reputation Scores in the Absence of Transactions

Although much of the above discussion relates to the generation of personalized transaction satisfaction scores (i.e. scores that reflect the likelihood a specific source user will be satisfied with a transaction conducted with a specific target user), processes similar to those outlined above can be utilized to leverage information available within the social graph to determine global reputation scores for users that have conducted very few or no online transactions. As noted above, global reputation is a reputation for a target that is not modified by the identity of the source. Global
reputations are commonly provided by services that facilitate online transactions. When a user has conducted few transactions, very little information is available upon which to base a global reputation score. In circumstances where information is available concerning the user's interactions via one or more online social networks, the information concerning the user's social graph can be utilized to formulate opinions concerning global reputation. In a number of embodiments, a set of highly reputable users or a whitelist of users is identified within one or more online social networks and the strength of the relationships between the user and whitelist of users is determined. Techniques similar to those outlined above can be utilized to score the relationship between the user and the users on the whitelist. In circumstances where a significant degree of separation exists between the user and the users on the whitelist, the number of paths that exist between the user and the user on the whitelist can be utilized as an indicator of the strength of the relationships. In several embodiments, the proportion of paths of a predetermined length that connect a user with a user in the whitelist can be utilized as an indicator of the global reputation of the user. Such a proportion can be estimated by conducting random walks that commence at the user's node within the social graph. In other embodiments, any of a variety of processes that score relationships between a user and a set of trusted users can be utilized to determine an initial global reputation score as appropriate to the requirements of specific applications. Furthermore, the processes described with respect to determining an initial global reputation score can be used in circumstances where transaction information is available as another technique for determining reputation and/or transaction scores.

[0068] A process for estimating an initial global reputation score with respect to a new user of a reputation dependent transaction system in accordance with an embodiment of the invention is illustrated in FIG. 10. The process 1000 includes obtaining (1002) a set of white list users. In several embodiments, white list users include a set of nodes within a graph database. In many embodiments, white list users include a variety of user profiles obtained from one or more online social networks. A relationship score is computed (1004) for a target user and one or more of the set of whitelist users. A trust score is computed (1006). In a number of embodiments, the trust score is computed based on the relationship score.
[0069] Although specific processes for determining initial global reputations for users that have conducted very few online transactions are described above with reference to FIG. 10, any of a variety of processes can be utilized to generate initial global reputation scores using information obtained from a social graph as appropriate to the requirements of specific applications in accordance with an embodiment of the invention.

Reputation Servers
[0070] A reputation server configured via a transaction scoring application to determine transaction scores for (source, target) pairs of users initiating transactions in accordance with an embodiment of the invention is illustrated in FIG. 11. In a variety of embodiments, the volatile memory 1120 and/or the non-volatile memory 1130 includes circuitry such as, but not limited to, memory cells constructed using transistors, that are configured to store instructions. Similarly, the processor 1110 can include logic gates formed from transistors (or any other device) that are configured to dynamically perform actions based on the instructions stored in the memory. In several embodiments, the instructions are embodied in a configuration of logic gates within the processor to implement and/or perform actions described by the instructions. In this way, the systems and methods described herein can be performed utilizing both general-purpose computing hardware and by single-purpose devices.

[0071] Although specific server implementations are described above with reference to FIG. 11, any of a variety of computing devices configured by appropriate machine readable instructions can be utilized to perform transaction scoring processes as appropriate to the requirements of specific applications in accordance with an embodiment of the invention.

Reputation Databases
[0072] As a reputation dependent transaction system scales, the manner in which data is stored within a reputation database maintained by the reputation dependent transaction system can significantly impact the real time performance and/or reliability of the system. A number of distributed computing platforms and file systems exist that
enable large tables of data to be distributed across arrays of computing devices including but not limited to the Apache Hadoop open-source software framework maintained by the Apache Software Foundation for storage and large-scale processing of data sets on clusters of commodity hardware. While distributed file systems such as Hadoop enable the storage and processing of data, the manner in which data is stored and indexed can have significant performance implications. Reputation dependent transaction systems in accordance with a number of embodiments of the invention maintain records concerning (source, target) pairs scored by the system. In certain embodiments, the nature of the record can depend upon the degree of separation between the (source, target) pair. In several embodiments, a list of (source, target) pairs that interact directly can be maintained. A list of (source, target) networks can also be maintained for (source target) pairs that do not interact directly. In embodiments where online social networks only expose partial views of a (source, target) network, information concerning directly connected (source, target) pairs and/or information concerning (source, target) networks that form subnetworks within another (source, target) network can be utilized to build more complete views of a given (source, target) network. As the ability to score a (source, target) network becomes increasingly dependent upon information maintained with respect to other directly connected (source, target) pairs, and/or (source, target) subnetworks, indexes can be maintained concerning the relationships that exist so that updates can be propagated to all impacted (source, target) networks.

[0073] FIGS. 12A and 12B illustrate data stored within a database of information describing (source, target) pairs in accordance with embodiments of the invention. The illustrated data can be retrieved to complete incomplete graphs of paths that connect transacting users. The table shown in FIGS. 12A and extending across FIG. 12B describes both directly connected (source, target) pairs and indirectly connected (source, target) pairs. In the illustrated embodiment, a field indicates whether the (source, target) pair are directly connected and the table includes a relationship score, the time the relationship score was generated, an index to (source, node) networks that include the (source, target) pair, and one or more access tokens for the source and node user that enable retrieval of information from one or more online social networks.
The table continues on FIG. 12B. The columns of the table shown in FIG. 12A can be utilized to describe a directly connected (source, target) pair. The additional columns shown in FIG. 12B enable the description of a (source, target) network and include a network score, a list of nodes that are one hop removed from the source node, a list of nodes that are two hops removed from the source node, and a list of nodes that are three hops removed from the source node. As can readily be appreciated, the access tokens can be utilized to continuously update the information about the relationship between directly connected (source, target) pairs or the relationships that exist within a (source, target) network. As the updates are made, the node score update index can be utilized to propagate the updates to (source, target) networks that include the given (source, target) pair or that contain the given (source, target) network as a sub-network.

[0074] Although specific database implementations are described above with reference to FIG. 12A and 12B, any of a variety of techniques for organizing data aggregated by a reputation server system can be utilized by reputation server systems as appropriate to the requirements of specific applications in accordance with embodiment of the inventions.

Transaction Servers

[0075] A transaction server configured by a reputation dependent transaction application to coordinate reputation dependent online transactions in accordance with an embodiment of the invention is illustrated in FIG. 13. In a variety of embodiments, the volatile memory 1320 and/or the non-volatile memory 1330 includes circuitry such as, but not limited to, memory cells constructed using transistors, that are configured to store instructions. Similarly, the processor 1310 can include logic gates formed from transistors (or any other device) that are configured to dynamically perform actions based on the instructions stored in the memory. In several embodiments, the instructions are embodied in a configuration of logic gates within the processor to implement and/or per-form actions described by the instructions. In this way, the systems and methods described herein can be performed utilizing both general-purpose computing hardware and by single-purpose devices.
Although specific server implementations are described above with reference to FIG. 13, any of a variety of computing devices configured by appropriate machine-readable instructions can be utilized to conduct relationship dependent online transactions as appropriate to the requirements of specific applications in accordance with an embodiment of the invention.

Although the present invention has been described in certain specific aspects, many additional modifications and variations would be apparent to those skilled in the art. In particular, any of the various processes described above can be performed in alternative sequences and/or in parallel (on the same or on different computing devices) in order to achieve similar results in a manner that is more appropriate to the requirements of a specific application. It is therefore to be understood that the present invention can be practiced otherwise than specifically described without departing from the scope and spirit of the present invention. Thus, embodiments of the present invention should be considered in all respects as illustrative and not restrictive. Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their equivalents.
WHAT IS CLAIMED IS:

1. A relationship dependent transaction system, comprising:
a transaction server system comprising a processor and a memory;
wherein the transaction server system:
   obtains transaction request data identifying a source user and a
target user;
determines a transaction score based on the transaction request
data for the source user and the target user by querying a reputation
database;
when the transaction score exceeds a threshold value, authorizes
the requested transaction; and
when the transaction score does not exceed the threshold value,
declines the requested transaction.

2. The relationship dependent transaction system of claim 1, further
comprising a reputation server system comprising a processor and a memory;
wherein the reputation server system:
   obtains user data describing one or more users of an online social
network;
determines relationship data between the source user and the
target user, where the source user and the target user are described in the
user data; and
generates transaction score data describing the relationship
between the source user and the target user.

3. The relationship dependent transaction system of claim 1, wherein the
transaction server system further generates recommendation data when the transaction
score does not exceed the threshold value, where the recommendation data concerns
actions that could raise the transaction score.
4. The relationship dependent transaction system of claim 3, wherein the recommendation data comprises metadata describing an endorsement from a third user, where the third user has a relationship with the source user and the target user.

5. The relationship dependent transaction system of claim 1, wherein the transaction score is determined based on relationship data describing the relationship between the source user and a target user in an online social network.

6. The relationship dependent transaction system of claim 5, wherein the relationship between the source user and the target user is a direct relationship.

7. The relationship dependent transaction system of claim 5, wherein the relationship data indicates negative interactions between the source user and the target user.

8. The relationship dependent transaction system of claim 5, wherein the relationship data describes mutual users that have relationships with both the source user and the target user.

9. The relationship dependent transaction system of claim 5, wherein:
   the relationship data comprises relationship age metadata describing the age of the relationship between the source user and the target user; and
   the relationship score is based on the relationship age metadata.

10. The relationship dependent transaction system of claim 1, wherein the relationship score is based on a degree of separation between the source user and the target user.

11. The relationship dependent transaction system of claim 10, wherein the degree of separation between the source user and the target user is calculated by selectively querying available social graphs from an online social network.
12. The relationship dependent transaction system of claim 11, wherein the available social graphs comprise a scored directed graph of relationships between users of the online social network.

13. The relationship dependent transaction system of claim 12, wherein:
   the source user is represented by a source user node in the scored directed graph;
   the target user is represented by a target user node in the scored directed graph; and
   the scored directed graph comprises a set of nodes that can be directly reached from the source user node.

14. A method for conducting relationship dependent transactions, comprising:
   obtaining transaction request data identifying a source user and a target user using a transaction server system comprising a processor and a memory;
   determining a transaction score based on the transaction request data for the source user and the target user using the transaction server system;
   when the transaction score exceeds a threshold value, authorizing the requested transaction using the transaction server system; and
   when the transaction score does not exceed the threshold value, declining the requested transaction using the transaction server system.

15. The method of claim 14, wherein the transaction score is determined by obtaining the transaction score from a reputation server system that:
   obtains user data describing one or more users of an online social network;
   determines relationship data between the source user and the target user, where the source user and the target user are described in the user data; and
   generates transaction score data describing the relationship between the source user and the target user.
Start

202 Obtain transaction (source, target) pair

204 Determine transaction score for (source, target) pair

206 Conduct transaction? No

Decline transaction

Yes

208 Authorize transaction

Recommend actions to increase (source, target) pair transaction score (optional)

Complete
Start

302 Obtain source and target profile data from social graph(s)

304 Connected? Yes

306 Score relationship

308 Determine transaction score for (source, target) pair based upon relationship score

310 No

312 Identify connections and/or affiliations between source and target

314 Score network and (optionally) affiliations

314 Determine transaction score for (source, target) pair based upon network score and (optionally) affiliation score

Complete

FIG. 3
FIG. 5
Start

Obtain profiles of source and target

Identify nodes connected to source and target

"Mutual friends"?

Yes

Score network based upon source and target activity with mutual friends

No

Determine paths to target via nodes connected to source

Score network based upon activity with and paths to target via each node connected to source

Complete

FIG. 7
FIG. 9

Start

902
Obtain profiles of source and target

904
Identify common named entities

906
Determine affiliation scores based upon number/type/characteristics of common named entities

Complete
FIG. 10

1000

Start

1002
Obtain white list users

1004
Compute relationship score for target and each whitelist user

1006
Compute trust score

Complete
### FIG. 12A

<table>
<thead>
<tr>
<th>(Source, Target)</th>
<th>DC</th>
<th>Relationship score</th>
<th>Relationship score timestamp</th>
<th>Node score update index</th>
<th>Social Network(s)</th>
<th>Access Token(s)</th>
<th>Access Token Expiration(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Source, Target)</td>
<td>DC</td>
<td>Relationship score</td>
<td>Relationship score timestamp</td>
<td>Node score update index</td>
<td>Social Network(s)</td>
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<td>(Source, Target)</td>
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<td>Access Token(s)</td>
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<td>(Source, Target)</td>
<td>DC</td>
<td>Relationship score</td>
<td>Relationship score timestamp</td>
<td>Node score update index</td>
<td>Social Network(s)</td>
<td>Access Token(s)</td>
<td>Access Token Expiration(s)</td>
</tr>
</tbody>
</table>

### FIG. 12B

<table>
<thead>
<tr>
<th>(Source, Target)</th>
<th>Network score</th>
<th>One hop nodes</th>
<th>Two hop nodes</th>
<th>Three hop nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Source, Target)</td>
<td>Network score</td>
<td>One hop nodes</td>
<td>Two hop nodes</td>
<td>Three hop nodes</td>
</tr>
<tr>
<td>(Source, Target)</td>
<td>Network score</td>
<td>One hop nodes</td>
<td>Two hop nodes</td>
<td>Three hop nodes</td>
</tr>
<tr>
<td>(Source, Target)</td>
<td>Network score</td>
<td>One hop nodes</td>
<td>Two hop nodes</td>
<td>Three hop nodes</td>
</tr>
<tr>
<td>(Source, Target)</td>
<td>Network score</td>
<td>One hop nodes</td>
<td>Two hop nodes</td>
<td>Three hop nodes</td>
</tr>
</tbody>
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INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8): H04M 15/00 (2015.01)

CPC - G06Q 40/025

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8): H04M 15/00 (2015.01); CPC: G06Q 40/025

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC: 705/38, 705/39

IPC(8): H04M 15/00 (2015.01); CPC: G06Q40/025, G06Q40/00, G06Q40/02, G06Q20/10, G06Q40/04

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, ProQuest Dialog, Google Web, Google Patents (Search terms: transaction score, threshold, minimum, relationship, reputation, database, storage, parameter, social network, endorse, third party, another, other, friend, mutual, recommend, degree of separation, level, directed graph, approve, authorize, value, etc.)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>X</td>
<td>US 2012/0290482 A1 (Atif et al.) 15 November 2012 (15.1.2012), para. [0007]-[0008], [0057]-[0058], [0061]-[0066], [0076], [0085]-[0083J, [0094], [0106], [0116], [0117]-[0120], [0133], [01580195], [0161], and [0166]-[0168], and Figs. 1, 6, and 9, and claim 1.</td>
<td>1, 14</td>
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<tr>
<td>Y</td>
<td>US 6,330,546 B1 (Gopinathan et al.) 11 December 2001 (11.12.2001), col. 4, ln. 30-33 and 50-58, col. 6, ln. 10-13, col. 25, ln. 56-58, and col. 27, ln. 12-14, 29-30, and 42-46, and Fig. 6.</td>
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<td>Y</td>
<td>US 2008/0228746 A1 (Markus et al.) 18 September 2008 (18.09.2008), para. [0011], [0063], [0065]-[0066], [0070], [0074]-[0077], [0101], [0117]-[0120], and [0124], and Figs. 5, 12, and 16.</td>
<td>10-13</td>
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</table>

Further documents are listed in the continuation of Box C.

Date of the actual completion of the international search
18 August 2015 (18.08.2015)

Date of mailing of the international search report
15 SEP 2015

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