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MACHINE-LEARNED DATABASE RECOMMENDATION MODEL

Abstract

A central database system trains a machine-learned model based on training data identifying characteristics of account holder entities, characteristics of account provider entities, and relationships between the account holder entities and account provider entities. For a target entity, the central database system then identifies a target set of account provider entities, and applies the trained machine-learned model to identify a subset of the target set of account provider entities. The identified subset of account provider entities are entities that, if recommended to the target entity, are most likely to result in an established relationship with the target entity. A recommendation is then generated for display to the target entity, the recommendation identifying the subset of account provider entities and including interface elements that, if selected by the target entity, cause a notification identifying the target entity to be sent to a corresponding account provider entity.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. application Ser. No. 18/657,620, filed May 7, 2024, which is a continuation of U.S. application Ser. No. 18/347,465, filed Jul. 5, 2023, now U.S. Pat. No. 12,008,450, which application is a continuation of U.S. application Ser. No. 17/887,513, filed Aug. 15, 2022, now U.S. Pat. No. 11,734,613, which is a continuation of U.S. application Ser. No. 17/012,054, filed Sep. 4, 2020, now U.S. Pat. No. 11,449,804, which is incorporated by reference in its entirety. [0002] This disclosure relates generally to database systems, and more specifically to training and applying machine-learned models in a database system.

BACKGROUND
[0003] Centralized database systems, such as employment management database systems, store large amount of data for the various entities associated with the database systems. In some embodiments, this data includes relationships between the entities associated with the database system. Accordingly, centralized database systems may be able to identify patterns and characteristics of the related entities, and thus may be positioned to offer valuable insight into the conditions associated with the establishment of such relationships.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0004] FIG. **1** is a block diagram of a system environment in which a central database system operates, according to one embodiment.
[0005] FIG. **2** is a data flow diagram illustrating the training and application of a machine-learned model, according to one embodiment.
[0006] FIG. **3** illustrates an example interface associated with the central database system, according to one embodiment.
[0007] FIG. **4** is a flowchart illustrating a process for training and applying a machine-learned model to recommend account provider entities to a target entity, according to one embodiment.
[0008] The figures depict various embodiments for purposes of illustration only. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated herein may be employed without departing from the principles described herein.
DETAILED DESCRIPTION
System Architecture
[0009] FIG. **1** is a block diagram of a system environment in which a central database system operates, in accordance with an embodiment. The system environment **100** shown by FIG. **1**

includes a central enrollment database system **110**, a network **120**, one or more account holder entities **130**, one or more account provided entities **140**, and a target entity **150**. The system environment **100** may have alternative configurations than shown in FIG. **1**, including for example different, fewer, or additional components.

[0010] The account holder entities **130**, the account provider entities **140**, and the target entity **150** communicate with each other and with the central database system **110** via one or more computing devices capable of receiving user input as well as transmitting and/or receiving data via the network **120**. Examples of computing devices include conventional computer systems (such as a desktop or a laptop computer, a server, a cloud computing device, and the like), client devices (such as smartphones, tablet computers, mobile devices, and the like), or any other device having computer functionality. The devices of the account holder entities **130**, the account provider entities **140**, and the target entity **150** are configured to communicate with the central database system **110** via the network **120**, for example using a native application executed by the devices or through an application programming interface (API) running on a native operating system of the devices, such as IOS® or ANDROID™. In another example, the devices of the account holder entities **130**, the account provider entities **140**, and the target entity **150** are configured to communicate with the central database system **110** via an API running on the central database system.

[0011] It should be noted that when reference is made to an account holder entity **130**, an account provider entity **140**, or the target entity **150** performing an action within the environment **100** of FIG. **1**, in practice it may be a device of the account holder entity, the account provider entity, or the target entity (respectively) that is performing the action, for instance at the direction of the account holder entity, the account provider entity, or the target entity.

[0012] Account holder entities **130** can include any entities associated with accounts of the central database system **110**. For instance, an account holder entity **130** may be an individual, an employee, an employer, a representative of a company or organization, and the like. As one example, an employer of 100 employees may be associated with an employer account within the central database system **110**, and may provide employee information (such as name, tile, biographic information, geographic information, salary, benefits, and the like) for each employee to the central database system **110**. The central database system **110**, in turn, may provision an account through the central database system for each employee, and thus each employee may also be an account holder entity **130**.

[0013] Account provider entities **140** can include any entity that enables the creation of a user account outside of the context of the central database system **110**. For instance, an account provider entity **140** may be a lawyer or law firm, an accountant or accounting firm, a component or materials supplier, an advisor, a venture capital firm or banking organization, a technology partner (such as an integration or IT provider), or any other suitable service or product provider. In some embodiments, each account provider entity is associated with an account of the central database system **110**. As used herein, “the creation of a user account outside of the context of the central database system **110**” can refer to the creation of a digital account through an online portal or computer system associated with an account provider entity **140**, can refer to a non-digital account with an account provider entity (such as an attorney-client engagement, a brokerage account, a business relationship, an execution of a contract or other agreement, and the like), and can refer to the establishment of any relationship or association between an account provider entity and another entity.

[0014] The target entity **150** is an account holder entity for which a recommendation of one or more account provider entities **140** is being made. For example, the target entity **150** can be an organization, company, individual, or the like. The central database system **110** can select the target entity **150** (as described below), or the target entity can be identified to the central database system, for instance in response to a request from an individual associated with the target entity **150**.

[0015] The central database system **110**, the account holder entities **130**, and the account provider

entities **140** are configured to communicate via the network **120**, which may comprise any combination of local area and/or wide area networks, using wired and/or wireless communication systems. In one embodiment, the network **120** uses standard communications technologies and/or protocols. For example, the network **120** includes communication links using technologies such as Ethernet, 802.11, worldwide interoperability for microwave access (WiMAX), 3G, 4G, code division multiple access (CDMA), digital subscriber line (DSL), etc. Examples of networking protocols used for communicating via the network **120** include multiprotocol label switching (MPLS), transmission control protocol/Internet protocol (TCP/IP), hypertext transport protocol (HTTP), simple mail transfer protocol (SMTP), and file transfer protocol (FTP). Data exchanged over the network **120** may be represented using any suitable format, such as hypertext markup language (HTML) or extensible markup language (XML). In some embodiments, all or some of the communication links of the network **120** may be encrypted using any suitable technique or techniques.

[0016] The central database system **110** is configured to receive and store various information associated with one or more entities, such as the account holder entities **130** and the account provider entities **140**. As described below, the central database system **110** is able to train and apply a machine-learned model to identify a subset of account provider entities from the set of account provider entities **140** that, if recommended to an account holder entity **130** ("target entity" hereinafter), are most likely to result in the creation or establishment of account with the target entity. The central database system **110** is able to leverage information stored by the central database system associated with the account holder entities **130** and the account provider entities in order to train the machine-learned model, beneficially enabling the central database system to generate recommendations that are more relevant to a target entity than the account holder entities **130** or the account provider entities **140** are individually able to generate.

[0017] In the embodiment of FIG. **1**, the central database system **110** includes an entity database **155**, a training information database **160**, a machine-learned model **165**, a training engine **170**, a recommendation engine **175**, and an interface engine. It should be noted that in other embodiments, the central database system **110** can include fewer, additional, or different components that those illustrated herein. In addition, in the embodiment of FIG. **1**, the central database system **110** is associated with an entity (such as a company or organization) different from the account holder entities **130** and the account provider entities **140**. Accordingly, the central database system **110** includes hardware (such as servers, networking equipment, databases or other storage devices, data center systems, and the like) distinct (and in some embodiments, physically remotely from) the devices associated with the account holder entities **130** and the account provider entities **140**.

[0018] The entity database **155** is configured to store information associated with the account holder entities **130** and the account provider entities **140**. In some embodiments, the information stored in the entity database **155** is information gathered from the account holder entities **130** and/or the account provider entities **140** as these entities are establishing accounts with the central database system **110**. For instance, the central database system **110** can be an enterprise software provider that provides human resources software to employers for use with employees. In this example, the employer may provide information describing characteristics of the employer and information describing characteristics of each of the employees to the central database system **110** during the course of provisioning accounts for the employees with the central database system. Likewise, account provider entities **140**, such as manufacturers, law firms, accounting firms, and the like can provide information describing the account provider entities, employees of the account provider entities, and customers of the account provider entities to the central database system **110** during the course of provisioning accounts for the employees and customers with the central database system. In other embodiments, information associated with the account holder entities **130** and account provider entities **140** can be provided to the central database system **110** for storage in the entity database **155** via any other suitable source or medium.

[0019] Examples of information associated an account holder entity **130** stored by the entity database **155** can include but are not limited to: a type of the account holder entity (e.g., a company, an educational institution, a professional or charitable association, an employer, an employee, a government organization, and the like), an age of the account holder entity (e.g., how long the entity has been in business, been established, etc.), a number of individuals or headcount associated with the account holder entity, an industry or focus associated with the account holder entity, a filing city or state associated with the account holder entity (e.g., where the account holder entity files taxes), a tax status of the account holder entity (e.g., for-profit business, non-profit organization, etc.), a state of incorporation or registration of the account holder entity, cities or states in which the account holder entity is present (e.g., does business, has offices, etc.), cities or states in which the account holder entity has employees or members, addresses associated with the account holder entity (e.g., addresses of offices of the account holder entity), software used by the account holder entity, revenue or profits of the account holder entity, geographic locations of customers of the account holder entity, account provider entities associated with the account holder entity, or any other suitable characteristic of the account holder entity.
[0020] Examples of information associated an account provider entity **140** stored by the entity database **155** can include but are not limited to: a type of the account provider entity (e.g., a company, a law firm, an account firm, an educational institution, a supplier, a manufacturer, a distributor, a venture capital organization, a banking or other financial institution, a technology provider or partner, and the like), an age of the account provider entity (e.g., how long the entity has been in business, been established, etc.), a number of individuals or headcount associated with the account provider entity, an average number of individuals or headcount associated with account holder entities associated with the account provider entity, an industry or focus associated with the account provider entity, an industry or focus associated with account holder entities associated with the account provider entity, a filing city or state associated with the account provider entity and associated with any account holder entities associated with the account provider entity, addresses associated with the account provider entity (e.g., addresses of offices of the account provider entity), a tax status of any account holder entities associated with the account provider entity, a state of incorporation or registration of the account provider entity or with any account holder entities associated with the account provider entity, cities or states in which the account provider entity is present or has offices, a geographic disbursement of account holder entities associated with the account provider entity, software used by the account provider entity, revenue or profits of account holder entities associated with the account provider entity, an identity or any other characteristics of account holder entities associated with the account provider entity, tax or finance issue expertise of the account provider entity, compliance expertise of the account provider entity, an industry expertise of the account provider entity, fundraising or selling expertise of the account provider entity, non-profit expertise and capabilities of the account provider entity (e.g., grant expertise, R&D expertise, and the like), services offered by the account provider entity, a service type associated with the account provider entity (e.g., an automated service, personal/hand-holding service, and the like), a current number of account holder entities associated with the account provider entity, a new client status of the account provider entity (whether the account provider entity is looking for new clients, how new clients the account provider entity is willing to accept, etc.), or any other suitable characteristic of the account holder entity.
[0021] The training information database **160** includes a set of training information used to train a machine-learned model. In some embodiments, the set of training information includes historical information stored by the entity database **155** associated with a set of account holder entities **130** and a set of account provider entities **140**, and historical information representative of relationships between the two sets of entities. For instance, the set of training information can include multiple entries, with each entry including information describing characteristics of an account holder entity **130**, information describing characteristics of an account provider entity **140** with which the

account holder entity has established an account, and information describing the relationship between the account provider entity and the account holder entity (such as a type of the account, when the account was established, the like).

[0022] The machine-learned model **165** is a model that is trained by the training engine **170** using the set of training information stored in the training information database **160**. The training engine **170** can train the machine-learned model **165** initially based on the set of training information, and can retrain the machine-learned model when the set of training information is updated (e.g., new information is added, one or more characteristics of an account holder entity **130** or an account provider entity has changed, and the like). The machine-learned model **165** can be retrained by the training engine **170** periodically, after the passage of a threshold amount of time, after the occurrence of a triggering event, at the request of a user or other entity associated with the central database system **110**, and the like.

[0023] The training engine **170** can implement one or more machine learning techniques to train the machine-learned model **165**. For instance, the machine-learned model can include one or more models, including but not limited to a linear support vector machine (linear SVM), boosting for other algorithms (e.g., AdaBoost), neural networks, logistic regression, naïve Bayes classifiers, memory-based learning techniques, random forest classifiers, bagged trees, decision trees, boosted trees, boosted stumps, a supervised or unsupervised learning algorithm, or any suitable combination thereof.

[0024] The machine-learned model **165** is trained based on the set of training information in order to identify one or more account provider entities **140** that, if recommended to an account holder entity **130**, are most likely to result in an established account or other relationship with the account holder entity. In some embodiments, the machine-learned model is trained to identify patterns or correlations between characteristics of account holder entities **130** in the set of training information and characteristics of associated account provider entities **140** in the set of training information. In these embodiments, based on these identified patterns and correlations, the machine-learned model can identify, based on characteristics of a target entity, one or more account provider entities **140** associated with characteristics correlated to the characteristics of the target entity.

[0025] FIG. **2** is a data flow diagram illustrating the training and application of a machine-learned model, according to one embodiment. In the embodiment of FIG. **2**, the machine-learned model **165** is trained using a training set of information **200**, including account holder information **210** (e.g., information representative of one or more account holder entities), account provider information **220** (e.g., information representative of one or more account provider entities), and account holder/provider relationship information **230** (e.g,. information describing relationships between the account holders and the account providers). The machine-learned model **165** receives information associated with a target entity **150** and information associated with candidate account providers **250** (e.g., a target set of account provider entities), and identifies a set of recommendations **260** including a subset of the candidate account providers **250** that, when recommended to the target entity **150**, are most likely to result in the establishment of an account with the target entity.

[0026] The recommendation engine **175** identifies a target entity **150** to which one or more account provider entities **140** are to be recommended. In some embodiments, the target entity **150** comprises an entity that does not have a relationship with a particular type of account provider entity. For instance, a company that does not have an account with an IT service provider can be selected, and one or more IT server providers can be recommended to the company. In some embodiments, the target entity **150** can be an entity that is requesting a recommendation to one or more account provider entities **140**. In some embodiments, the recommendation engine **175** can identify the target entity **150** based on characteristics of the target entity (e.g., when the target entity grows to a certain headcount, the target entity can be selected so that a law firm can be recommended), based on a time or date (e.g., a target entity can be selected so that an accounting

firm can be recommended within two months of tax day), based on relationships established by similar entities with account provider entities (e.g., if several companies in a particular industry within a particular geographic area are establishing relationships with manufacturers within the same industry, a company within the particular industry and particular geographic area can be selected as the target entity), or based on any other suitable criteria.

[0027] The recommendation engine **175** then identifies a set of characteristics associated with the target entity **150**. Examples of the identified set of characteristics include a size of the target entity **150**, an industry of the target entity, a filing state of the target entity, or any other suitable characteristics (such as any of the characteristics described above with regards to the account holder entities **130** or the account provider entities **140** and stored within the entity database **155**).

[0028] The recommendation engine **175** identifies a target set of account provider entities, among which a subset will be selected for recommendation to the target entity **150**. The target set of account provider entities are selected from among the account provider entities **140**. In some embodiments, the target set of account provider entities comprise entities that have one or more characteristics in common with the target entity **150**, and/or are selected based on characteristics of the target entity. For instance, the target set of account provider entities can be entities located in a same geographic region or state as the target entity **150**, entities that operate in a same industry as the target entity, and the like. In some embodiments, the target set of account provider entities comprise all or a subset of the account provider entities **140** associated with a particular entity type. For instance, if the target entity is determined to not have a relationship or account with an email provider, the target set of account provider entities can be all email providers within the account provider entities **140**. In some embodiments, the target set of account provider entities comprise entities within the account provider entities **140** that are seeking to accept new clients or customers. In other embodiments, the target set of account provider entities includes all of the account provider entities **140** (for instance, in embodiments where all of the account provider entities **140** are account provider entities of a particular type, such as enterprise software providers or accounting firms). In practice, any combination of the above factors or any other suitable factors may be used to select the target set of account provider entities.

[0029] The recommendation engine **175** identifies a set of characteristics associated with each of the target set of account provider entities. Example characteristics in the identified sets of characteristics include a size of the account provider entity, an industry of the account provider entity, a filing state of the account provider entity, or any other suitable characteristics (such as any of the characteristics described above with regards to the account holder entities **130** or the account provider entities **140** and stored within the entity database **155**).

[0030] The recommendation engine **175** applies the machine-learned model **165** to the identified set of characteristics associated with the target entity **150** and the identified sets of characteristics associated with the target set of account provider entities, and the machine-learned model outputs a subset of the target set of account provider entities to recommend to the target entity. As described above, the subset of the target set of account provider entities are the account provider entities that, when recommended to the target entity **150**, are most likely to result in an established account or other relationship or association with the account holder entity.

[0031] The subset of the target set of account provider entities output by the machine-learned model **165** may include the account provider entity most likely to result in an established account or relationship with the target entity when recommended to the target entity. The subset of the target set of account provider entities may also include all account provider entities within the target set of account provider entities that are associated with an above-threshold likelihood to, when recommended to the target entity, result in an established account or relationship with the target entity. The subset of the target set of account provider entities may also include a threshold number of the target set of account provider entities that are most likely to result in an established account or relationship with the target entity.

[0032] In some embodiments, the machine-learned model **165** is configured to recommend a first account provider entity that services account holder entities associated with an average headcount that is within a threshold headcount of a target entity over a second account provider entity that services account holder entities with an average headcount more than a threshold headcount away from the target entity. For instance, for a target entity with a headcount of 100 employees, the machine-learned model **165** can recommend a first account provider entity with clients that have an average headcount of 110 over a second account provider entity with clients that have an average headcount of 60 or 180.

[0033] In some embodiments, the machine-learned model **165** is configured to recommend a first account provider entity that services a threshold number or threshold percentage of account holder entities associated with a same filing state as the target entity over a second account provider entity that services less than a threshold number or threshold percentage of account holder entities associated with the same filing state. For instance, for a target entity with a filing state of California, the machine-learned model **165** can recommend a first account provider where 60% of the first account provider's clients file in California over a second account provider entity where 20% of the second account provider's clients file in California.

[0034] In some embodiments, the machine-learned model **165** is configured to recommend a first account provider entity that services a threshold number or threshold percentage of account holder entities associated with a same industry as the target entity over a second account provider entity that services less than a threshold number or threshold percentage of account holder entities associated with the same industry. For instance, for a target entity associated with robotics manufacturing, the machine-learned model **165** can recommend a first account provider where 90% of the first account provider's clients are in the robotics manufacturing industry over a second account provider entity where 40% of the second account provider's clients are in the robotics manufacturing industry.

[0035] In some embodiments, the machine-learned model **165** is configured to identify account provider entities based on any suitable factors. For instance, the machine-learned model **165** may be more likely to select account provider entities based on a capacity of the account provider entities (e.g., the number of account holder entities **130** associated with each account provider entity, the number of new account holder entities an account provider entity is willing to take on, etc.) Likewise, the machine-learned model **165** may be more likely to select account provider entities that specialize in an unusual, uncommon, or rare specialty (for instance, if only one, a few, or less than a threshold number of account provider entities associated with the central database system **110** are associated with the specialty).

[0036] In some embodiments, the machine-learned model **165** is configured to identify account provider entities based on a number of percentage of account holder entities that end relationships or accounts with each account provider entity, based on a maximum number of account holder entities that each account provider entity can service or have a relationship with, a number of counter or reciprocal referrals each account provider entity has made (e.g., a number of entities that each account provider entity has recommended the central database system **100** to), and the like.

[0037] It should be emphasized that the machine-learned model **165** can be configured to identify account provider entities based on any characteristic of the target entity **150**, any characteristic of an account provider entity, any combination of the factors or characteristics described herein, or any other suitable characteristic.

[0038] The interface engine **180** coordinates communications between the entities of FIG. **1**. For instance, the interface engine **180** receives information describing characteristics of the account holder entities **130**, the account provider entities **140**, and the target entity **150** (for instance, while onboarding and provisioning accounts within the central database system **110** for these entities), and stores the received information in the entity database **155**. Likewise, the interface engine **180** can provide recommendations for the identified subset of account provider entities to the target

entity **150**. In some embodiments, the interface engine **180** generates and causes display of one or more graphic user interfaces (GUIs), for instance for display by a device of an account holder entity **130**, a device of an account provider entity **140**, and/or a device of the target entity **150**.
[0039] Upon identifying a subset of the target set of account provider entities to recommend to the target entity **150**, the interface engine **180** causes display of a notification within an interface displayed by a device associated with the target entity. In some embodiments, the interface displayed by the device associated with the target entity **150** includes a GUI displayed by an application executed by the device and associated with the central database system **110**. In such embodiments, the notification can identify the subset of account provider entities along with text indicating that a relationship or account with one or more of the subset of account provider entities is recommended by the central database system **110**. In some embodiments, the interface includes one or more interface elements (for instance, one interface element corresponding to each entity within the subset of account provider entities) that, when interacted with, causes a message or notification identifying the target entity to be sent to the account provider. In some embodiments, instead of a notification displayed within an interface of an application associated with the central database system **110**, the recommended subset of account provider entities can be emailed, texted, or otherwise communicated to the target entity **150** for display within a different interface by a device of the target entity.
[0040] FIG. **3** illustrates an example interface associated with the central database system, according to one embodiment. The user interface **300** is displayed by a device of the target entity **150**. At the top of the user interface **300** is recommendation text **310** that communicates to the target entity that 1) the central database system **100** recognized that the target entity is not associated with a component manufacture, 2) that the central database system identified candidate component manufacturers, and 3) asks the target entity if they would like a recommendation. The recommended account provider entities **320** are displayed within the user interface **300**, in this case the component manufacturers “Acme Inc.”, “Baltic & Sons”, and “Calvin's Co.” The user interface **300** further includes acceptance interface elements **330** that, when interacted with, cause a message or notification identifying the target entity **150** to be sent to the corresponding component manufacturer. The user interface **300** further includes message interface elements **340** that enable the target entity **150** to customize the message or notification sent to the component manufacturer (either a default referral message, or a target entity-created custom referral message).
[0041] When the target entity **150** accepts a recommendation (e.g., by selecting the interface element associated with a recommendation, when the target entity requests a referral, and the like), a message or notification identifying the target entity is sent for display by a device associated with the account provider entity associated with the accepted recommendation. The message or notification can include introductory text explaining that the target entity accepted a recommendation to the account provider entity associated with the accepted recommendation. For example, the message can say “Hello, the potential client XYZ has expressed interest in establishing an account with you. Would you like an introduction?”
[0042] In some embodiments, the account provider entity device displays the message or notification within an application interface corresponding to the central database system **110**, while in other embodiments, the message is displayed as an email, a pop up window, a text message, or any other suitable form. The account provider entity associated with the accepted recommendation can, in response to accepting the referral (e.g., by selecting an interface element requesting to be introduced to the target entity **150**, by sending a message to the target entity, and the like), initiate communication with the target entity. In some embodiments, the communication occurs via the central database system **100** (for instance, within an application corresponding to the central database system), while in other embodiments the communication occurs outside of the context of the central database system (in which case, either the target entity **150** or the account provider entity associated with the accepted recommendation can inform the central database system of the

status of the recommendation). In some embodiments, in response to either the establishment or failure of an establishment of a relationship or account between the target entity **150** and the provider entity associated with the accepted recommendation, the central database system **100** can update the set of training information stored within the training information database **160**, and the training engine **170** can retrain the machine-learned model **165** based on the updated set of training information.

[0043] FIG. **4** is a flowchart illustrating a process for training and applying a machine-learned model to recommend account provider entities to a target entity, according to one embodiment. It should be noted that in other embodiments, the process illustrated by FIG. **4** can include fewer, additional, or different steps than those described herein.

[0044] A training set of information is accessed **410** describing characteristics of account holder entities, account provider entities, and associated relationships between the account holder entities and account provider entities. In some embodiments, each account holder entity is associated with at least a first account provided by a central database system, and are associated with at least a second account provided by one or more of the account provider entities.

[0045] A machine-learned model is trained **420** using the accessed training set of information to identify account provider entities to recommend to prospective account holder entities. In particular, the machine-learned model can be trained to identify account provider entities that, if recommended to a particular entity, are most likely to result in an account being established between the particular entity and the account provider entities. As noted above, the machine-learned model can be a neural network, a Bayes classifier, a linear support vector machine, and the like.

[0046] The central database system identifies **430** a target entity associated with the central database system, and identifies **440** a target set of account provider entities based on characteristics of the identified target entity. For instance, the target entity can be an entity associated with an account of the central database system, but not associated with a particular type of account offered by the target set of account provider entities. Likewise, the identified target set of account provider entities can be account provider entities associated with a geographic region associated with the target entity, an industry associated with the target entity, and the like.

[0047] The central database system applies **450** the machine-learned model to characteristics of the target entity and characteristics of the target set of account provider entities to identify a subset of the account provider entities. The target entity is notified **460** of the identified subset of the account provider entities, for instance within a notification generated for display within a recommendation interface. The notification can include, for each of the subset of account provider entities, an interface element that, when selected, generates a notification identifying the target entity for display to the corresponding account provider entity.

Additional Considerations

[0048] The foregoing description of the embodiments has been presented for the purpose of illustration; it is not intended to be exhaustive or to limit the patent rights to the precise forms disclosed. Persons skilled in the relevant art can appreciate that many modifications and variations are possible in light of the above disclosure.

[0049] Some portions of this description describe the embodiments in terms of algorithms and symbolic representations of operations on information. These algorithmic descriptions and representations are commonly used by those skilled in the data processing arts to convey the substance of their work effectively to others skilled in the art. These operations, while described functionally, computationally, or logically, are understood to be implemented by computer programs or equivalent electrical circuits, microcode, or the like. Furthermore, it has also proven convenient at times, to refer to these arrangements of operations as modules, without loss of generality. The described operations and their associated modules may be embodied in software, firmware, hardware, or any combinations thereof.

[0050] Any of the steps, operations, or processes described herein may be performed or implemented with one or more hardware or software modules, alone or in combination with other devices. In one embodiment, a software module is implemented with a computer program product comprising a computer-readable medium containing computer program code, which can be executed by a computer processor for performing any or all of the steps, operations, or processes described.
[0051] Embodiments may also relate to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, and/or it may comprise a general-purpose computing device selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a non-transitory, tangible computer readable storage medium, or any type of media suitable for storing electronic instructions, which may be coupled to a computer system bus. Furthermore, any computing systems referred to in the specification may include a single processor or may be architectures employing multiple processor designs for increased computing capability.
[0052] Embodiments may also relate to a product that is produced by a computing process described herein. Such a product may comprise information resulting from a computing process, where the information is stored on a non-transitory, tangible computer readable storage medium and may include any embodiment of a computer program product or other data combination described herein.
[0053] Finally, the language used in the specification has been principally selected for readability and instructional purposes, and it may not have been selected to delineate or circumscribe the patent rights. It is therefore intended that the scope of the patent rights be limited not by this detailed description, but rather by any claims that issue on an application based hereon. Accordingly, the disclosure of the embodiments is intended to be illustrative, but not limiting, of the scope of the patent rights, which is set forth in the following claims.

Claims

1. A central database system comprising: a hardware processor; and a non-transitory computer-readable storage medium storing executable instructions that, when executed by the hardware processor, cause the hardware processor to perform steps comprising: accessing a machine-learned model trained configured to identify one or more account provider entities to recommend to an account holder entity using information describing a first set of account holder entities and a second set of account provider entities, each account holder entity associated with at least one account provider entity; identifying a target entity associated with one or more central database system accounts, the target entity associated with one or more of a target entity category, a target entity status, and a target entity headcount; applying the trained machine-learned model to one or more of the target entity category, the target entity status, and the target entity headcount to identify a subset of the account provider entities to recommend to the target entity; and establishing a communication session between the target entity and an account provider entity of the subset of account provider entities.
2. The central database system of claim 1, wherein a first entity in the first set of account holder entities is associated with a second account provided by a second entity in the second set of account provided entities, the second account different from the one or more central database system accounts associated with the first entity, and the second entity different from the central database system.
3. The central database system of claim 1, wherein identifying the target entity comprises identifying an entity that does not have a relationship with a particular type of account provider entity.
4. The central database system of claim 3, wherein identifying the target set of account provider

entities comprises identifying account provider entities associated with the particular type of account.

5. The central database system of claim 1, wherein the target set of account provider entities comprises all account provider entities determined by the machine-learned model to be associated with an above-threshold likelihood to, when recommended to the target entity, result in an established account with the target entity.

6. The central database system of claim 1, wherein the target set of account provider entities comprises a threshold number of account provider entities determined by the machine-learned model to be most likely to, when recommended to the target entity, result in an established account with the target entity.

7. The central database system of claim 1, wherein the target set of account provider entities comprises a subset of all account providers associated with the central database system that are located within a same state or city as the target entity.

8. The central database system of claim 1, wherein the machine-learned model recommends account provider entities that service entities with an average headcount within a threshold headcount of the target entity over account provider entities that service entities with an average headcount more than a threshold headcount away from the target entity.

9. The central database system of claim 1, wherein the machine-learned model recommends account provider entities that service a threshold number of entities associated with the target entity location over account provider entities that service less than the threshold number of entities associated with the target entity location.

10. The central database system of claim 1, wherein the machine-learned model recommends account provider entities that service a threshold number of entities associated with the target entity industry over account provider entities that service less than the threshold number of entities associated with the target entity industry.

11. A method comprising: accessing a machine-learned model trained configured to identify one or more account provider entities to recommend to an account holder entity using information describing a first set of account holder entities and a second set of account provider entities, each account holder entity associated with at least one account provider entity; identifying a target entity associated with one or more central database system accounts, the target entity associated with one or more of a target entity category, a target entity status, and a target entity headcount; applying the trained machine-learned model to one or more of the target entity category, the target entity status, and the target entity headcount to identify a subset of the account provider entities to recommend to the target entity; and establishing a communication session between the target entity and an account provider entity of the subset of account provider entities.

12. The method of claim 11, wherein a first entity in the first set of account holder entities is associated with a second account provided by a second entity in the second set of account provided entities, the second account different from the one or more central database system accounts associated with the first entity, and the second entity different from the central database system.

13. The method of claim 11, wherein identifying the target entity comprises identifying an entity that does not have a relationship with a particular type of account provider entity.

14. The method of claim 13, wherein identifying the target set of account provider entities comprises identifying account provider entities associated with the particular type of account.

15. The method of claim 11, wherein the target set of account provider entities comprises all account provider entities determined by the machine-learned model to be associated with an above-threshold likelihood to, when recommended to the target entity, result in an established account with the target entity.

16. The method of claim 11, wherein the target set of account provider entities comprises a threshold number of account provider entities determined by the machine-learned model to be most likely to, when recommended to the target entity, result in an established account with the target

entity.

17. The method of claim 11, wherein the target set of account providers comprises a subset of all account provider entities associated with the central database system that are located within a same state or city as the target entity.

18. The method of claim 11, wherein the machine-learned model recommends account provider entities that service entities with an average headcount within a threshold headcount of the target entity over account provider entities that service entities with an average headcount more than a threshold headcount away from the target entity.

19. The method of claim 11, wherein the machine-learned model recommends account provider entities that service a threshold number of entities associated with the target entity location over account provider entities that service less than the threshold number of entities associated with the target entity location.

20. The method of claim 11, wherein the machine-learned model recommends account provider entities that service a threshold number of entities associated with the target entity industry over account provider entities that service less than the threshold number of entities associated with the target entity industry.