Title: MULTIDIMENSIONAL DATA PROCESSING METHOD AND DEVICE

(54) Realize information of dimensions, information of attributes in each of the dimensions and information of layer correlation of the attributes from a database

(57) Abstract: Multidimensional data processing method and device are used in computers to simplify computation without repetitive acquisition of attribute measure data in a variety of dimensions from the entire account data. The method for multidimensional data analysis includes realizing information of dimensions, attributes in the dimensions and layer correlation of the attributes; realizing a finest attribute in each dimension according to the above-mentioned information; generating a top-layer set of attributes according to the finest attribute in each of the dimensions; generating a recursive topologic structure according to the top-layer set of attributes and layer correlation of the attributes, the recursive topologic structure including a set of attributes and recursive paths among the set of attributes; and receiving a search request, and recursing measure data corresponding to an attribute set associated with the search request according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.
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MULTIDIMENSIONAL DATA PROCESSING METHOD AND
DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates to a technical field of computers, and more particularly to multidimensional data processing method and device.

BACKGROUND OF THE INVENTION

[0002] With current technical development of internet and computers, multidimensional data analysis is widely used in a variety of data analytics platforms. Multidimensional data analysis is a part of the OLAP (On-Line Analytical Processing) technique and as a matter of fact, is the core technique. Multidimensional data analysis functions for observing and parsing variations of measures in order to signify some of the measures according to selected important dimensions.

[0003] Nowadays, there are a lot of websites, e.g. shopping or self-analysis platforms, adopting multidimensional data analysis. For example, as shown in FIG. 1, for analyzing numbers of purchasers in different age divisions buying specified goods on a shopping platform, age is set as a condition for sifting the account data. In this example, age is a dimensional attribute while a number of purchasers is measure data. From FIG. 1, it is shown that only one dimensional attribute concerning age is revealed in the data analysis result of the shopping platform. If any further dimensional data, e.g. numbers of purchasers in each age in each city region, numbers of purchasers in each age in each province region and/or numbers of purchasers in each age division in each province region, are to be revealed for analysis involving multidimensional attributes, it needs to sift the entire account database to realize each and every measure data in a dimensional attribute set. A general sifting process is performed by first obtaining data associated with a specified dimensional attribute from the entire account database, then screening the obtained data according to the other dimensional attributes in the dimensional attribute set one by one. Finally,
measure data complying with all the conditions of dimensional attributes in the dimensional attribute set.

Therefore, if there are many dimensions and dimensional attributes involved for repetitively screening out a variety of measure data from the entire account database, the computation would be very complicated.

**SUMMARY OF THE INVENTION**

An embodiment of the present invention provides method and device for processing multidimensional data to solve the complicated computing problem in the case that a lot of dimensions and dimensional attributes are involved for repetitively screening out a variety of measure data from the entire account database.

The above object can be achieved by adopting the following technical solutions according to the present invention.

A multidimensional data processing method, comprising:

- realizing information of dimensions, information of attributes in each of the dimensions and information of layer correlation of the attributes from a database;
- realizing a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes;
- generating at least one top-layer set of attributes according to the finest one of the attributes in each of the dimensions;
- generating a recursive topologic structure according to the at least one top-layer set of attributes and the information of layer correlation of the attributes, the recursive topologic structure including a set of attributes and recursive paths among the set of attributes; and
- receiving a search request, and recursing measure data corresponding to an attribute set associated with the search request according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.
A multidimensional data processing device, comprising:

- an acquisition unit realizing information of dimensions, information of attributes in each of the dimensions and information of layer correlation of the attributes from a database;

  wherein the acquisition unit further realizes a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes;

- a generation unit generating at least one top-layer set of attributes according to the finest one of the attributes in each of the dimensions;

  wherein the generation unit further generates a recursive topologic structure according to the at least one top-layer set of attributes and the information of layer correlation of the attributes, the recursive topologic structure including a set of attributes and recursive paths among the set of attributes; and

- a recursion unit receiving a search request, and recursing measure data corresponding to an attribute set associated with the search request according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.

The embodiments according to the present invention provide multidimensional data processing method and device. Since a recursive topological structure is generated according to the top-layer sets of attributes and the information of layer correlation of the attributes, wherein the recursive topologic structure includes a set of attributes and recursive paths among the set of attributes, when receiving a search request, measure data corresponding to an attribute set associated with the search request can be realized by way of recursion according to the recursive paths and a specified measure data corresponding to a previously specified attribute set. According to prior art, when measure data corresponding to an attribute set is required, it is necessary to acquire measure data associated with a variety of dimensional
attribute sets from the account database, so the computation is relatively complicated. On the other hand, according to the present invention, measure data corresponding to unknown attribute sets can be realized according to the recursive topological structure and a specified measure data corresponding to a previously specified attribute set, thereby simplifying the computation.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0010] In order to have the technical solutions according to the present invention or the prior art understood in a better way, drawings required for subsequently describing the embodiments of the present invention or prior art are briefly described herein. It is known to those ordinary skilled in the art that the drawings described as follows are only for illustrating embodiments or examples of the present invention, and associated drawings can be realized accordingly without creative efforts, in which:

[0011] FIG. 1 is a displayed frame showing a data analysis interface according to prior art;

[0012] FIG. 2 is a flowchart illustrating a multidimensional data processing method according to an embodiment of the present invention;

[0013] FIG. 3 is a flowchart illustrating a multidimensional data processing method according to another embodiment of the present invention;

[0014] FIG. 4 is a scheme illustrating mapping relationship between fields in the account data and measures and dimensions according to an embodiment of the present invention;

[0015] FIG. 5 is a scheme illustrating the data change in a multidimensional data processing method according to an embodiment of the present invention;

[0016] FIG. 6 is a recursive topologic scheme according to an embodiment of the present invention;

[0017] FIG. 7 is another recursive topologic scheme according to an embodiment of the present invention;

[0018] FIG. 8 is a schematic block diagram of a multidimensional data processing device according to an embodiment of the present invention; and
FIG. 9 is a schematic block diagram of a multidimensional data processing device according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, with reference to the drawings, the technical solutions according to embodiments of the present invention will be described in a clear and complete way. However, it is to be noted that the embodiments are only described as examples instead of covering all the possible embodiments. Based on the following embodiments, those ordinary in the art may realize alternative embodiments and examples without creative efforts, which are within the scope of the present invention.

In order to make the advantages of the technical solutions according to the present invention understood in a better way, descriptions of embodiments according to the present invention are given as follows with reference to the drawings.

As shown in FIG. 2, a multidimensional data processing method according to an embodiment of the present invention comprises the following steps.

In Step 101, information of dimensions, information of attributes in each of the dimensions and information of layer correlation of the attributes are realized from a database.

The step further obtains account data of a data business, which is day-to-day account data recorded in a database when the data business, e.g. a website, an application program or an online game, is used. Each dimension in the information of dimensions indicates a selected view for data analysis, and for example, can be regions or ages of users of an application program at issue. The information of attributes in each of the dimensions includes attributes of different sizes in the same dimension, e.g. day, week, month or year in a time dimension. The information of layer correlation of the attributes includes various kinds of layer correlation of the attributes, e.g. 7 days being equal to 1 week, 12 months being equal to 1 year in a time dimension, or several city regions being included in one province region which is further included in a country in a region dimension.
In Step 102, a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes is realized.

The finest attribute is the attribute of the smallest size among the information of attributes in the same dimension. For example, in a time dimension, the attributes included in the information of attributes include year, month, day and hour, and then the attribute "hour" is the finest one of the attributes in the time dimension.

In Step 103, at least one top-layer set of attributes is generated according to the finest one of the attributes in each of the dimensions.

After one or more finest attributes are acquired in Step 102, the one or more finest attributes constitute the at least one top-layer set of attributes. The top-layer set of attributes is directly acquired from the account data. For example, the acquired finest attributes are city, age and primary source, and thus the top-layer set of attributes is constituted by city, age and primary source. The primary source belongs to a source dimension, and the source dimension may include a primary source and a secondary source, wherein the primary source may be real data source, e.g. a real website. Then the secondary source may be a set of the websites. For example, the websites belong to a social network.

In Step 104, a recursive topologic structure is generated according to the at least one top-layer set of attributes and the information of layer correlation of the attributes, wherein the recursive topologic structure includes a set of attributes and recursive paths among the set of attributes.

For multidimensional data processing, roll-up of a set of attributes is generally conducted to generate a next-layer set of attributes. The roll-up operation may be performed in two ways. The first one is to remove one of the attributes in the set of attributes so as to obtain the next-layer set of attributes. For example, in a set of attributes containing city, age and primary source, the primary source may be removed in the roll-up operation to form the next-layer set of attributes containing city and age. The other way is to enlarge the size of the attributes in the set of attributes according
to the layer correlation of the attributes. For example, in a set of attributes containing city, age and primary source, since city belongs to a region dimension which further includes attributes of country and province, the attribute "city" in the set of attributes may be replaced by "province" for roll-up, thereby enlarging the size of attributes and generate another set of attributes containing province, age and primary source. After the roll-up operation in either of the above-mentioned ways, a general attribute is formed without limit to the set of attributes.

[0031] In Step 105, a search request is received, and measure data corresponding to an attribute set associated with the search request is recursed according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.

[0032] After the recursive topological structure is built, measure data corresponding to a part of the set of attributes in the recursive topological structure is acquired first. The search request is accompanied by an attribute set to be analyzed. After the search request is received, measure data corresponding to the attribute set associated with the search request can be recursed according to the recursive paths and the measure data corresponding to the previously acquired attribute set. For example, data of a registration number corresponding to an attribute set containing city, age and primary source is previously acquired. Then according to the recursive paths, it is realized that the next-layer set of attributes is an attribute set containing city and age, so data of a registration number corresponding to the next-layer set of attributes containing city and age is acquired.

[0033] It is to be noted that the host to execute the multidimensional data processing method provided according embodiments of the present invention can be a multidimensional data processing device. The multidimensional data processing device can be implemented in, but not limited to, electronic equipment such as a computer or an internet server.

[0034] In the multidimensional data processing method provided according embodiments of the present invention, since a recursive topologic structure is
generated according to the at least one top-layer set of attributes and the information of layer correlation of the attributes, wherein the recursive topologic structure includes a set of attributes and recursive paths among the set of attributes. Therefore, when a search request is received, measure data corresponding to an attribute set associated with the search request can be recursed according to the recursive paths and a specified measure data corresponding to a previously specified attribute set. In contrast, according to prior art, when measure data corresponding to an attribute set is required, it is necessary to acquire measure data associated with a variety of dimensional attribute sets from the account database, so the computation is relative complicated. In the present invention, measure data corresponding to unknown attribute sets can be realized according to the recursive topological structure and a specified measure data corresponding to a previously specified attribute set, thereby simplifying the computation.

[0035] Hereinafter, another embodiment will be described in more detail with reference to FIG. 3. The embodiment of a multidimensional data processing method provided according to the present invention includes the following steps.

[0036] In Step 201, account data of a data business, information of dimensions in the data business, information of attributes in each of the dimensions and information of layer correlation of the attributes are acquired.

[0037] The account data of a data business is day-to-day account data recorded in a database when the data business, e.g. a website, an application program or an online game, is used. The account data may contain a user identity, a registration website, and an operation being performed. Each dimension in the information of dimensions indicates a selected view for data analysis, and for example, can be regions or ages of users of an application program at issue. The information of attributes in each of the dimensions includes attributes of different sizes in the same dimension, e.g. day, week, month or year in a time dimension. The information of layer correlation of the attributes includes various kinds of layer correlation of the attributes, e.g. 7 days being equal to 1 week, 12 months being equal to 1 year in a time dimension, or several city
regions being included in one province region which is further included in a country in a region dimension.

[0038] After the account data is acquired, it is necessary to establish mapping relationship between fields in the account data and measures and dimensions. For example, in the account data, a specified field included in the user identity may correspond to the dimension of region or the dimension of age. In another example, a specified field included in the website may correspond to the dimension of source. Examples are not limited to the above. FIG. 4 schematically illustrates an example of mapping relationship between fields in the account data and measures and dimensions. As shown, the user identity corresponds to the dimension of region and the dimension of age. The dimension of region includes attributes of city, city level, province, and country. The dimension of age includes age and age division. Furthermore, the website corresponds to the dimension of source. The dimension of source includes primary source and secondary source, wherein the primary source may be real data source, e.g. a real website, and the secondary source may be a set of the websites. For example, the websites belong to a social network.

[0039] In Step 202, a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes is realized.

[0040] The finest attribute is the attribute of the smallest size among the information of attributes in the same dimension. For example, in a time dimension, the attributes included in the information of attributes include year, month, day and hour, and then the attribute "hour" is the finest one of the attributes in the time dimension.

[0041] In Step 203, at least one top-layer set of attributes is generated according to the finest one of the attributes in each of the dimensions.

[0042] After one or more finest attributes are acquired in Step 202, the one or more finest attributes constitute the at least one top-layer set of attributes. The top-layer set of attributes is directly acquired from the account data. For example, the acquired finest attributes are city, age and primary source, and thus the top-layer set of
attributes is constituted by city, age and primary source.

[0043] In Step 204, each set of attributes is traversed, and whether the set of attributes to be rolled up are general attributes or not is determined.

[0044] Step 205 is executed if the set of attributes are determined to be general attributes.

[0045] Step 206 is executed if the set of attributes are determined to be non-general attributes.

[0046] The set of attributes being traversed is not limited to the top-layer set of attributes. After Step 201 through Step 204 is performed, a variety of sets of attributes can be sequentially generated. Therefore, it is necessary to traverse the sets of attributes so as to gradually form a recursive topologic structure. A general attribute is formed as a number of the attributes contained in the set of attributes is getting less and less and the attribute size becomes larger and larger with the stepwise roll up of the set of attributes, and finally no limitation for a set of attributes exists. For example, in a case that a registration number of a certain website is to be realized, the data of registration numbers in each city and at each age are realized if the set of attributes contains attributes of city and age. As a result of roll up, there will be no dimension of region and dimension of age in the final general attribute. Accordingly, the registration number will be the total registration number of the website.

[0047] In Step 205, go back to Step 204 if it is determined that no further roll-up of the set of attributes is available.

[0048] If it is determined that the set of attributes are general attributes, none of the attributes in the set of attributes can be removed, and the attribute size in the set of attributes cannot be enlarged. Then, no roll-up can be done.

[0049] In Step 206, each attribute in the set of attributes to be rolled up is traversed.

[0050] In Step 207, whether a measure corresponding to the set of attributes needs to undergo universal duplication removal is determined.

[0051] If it is determined that the measure corresponding to the set of attributes
needs to undergo universal duplication removal, execute Step 208.

[0052] If it is determined that the measure corresponding to the set of attributes does not need to undergo universal duplication removal, execute Step 209.

[0053] The measure corresponding to the set of attributes is a measure analyzed according to the requirement of the set of attributes, and in general, can be acquired by analyzing the account data. For example, as illustrated in FIG. 5, identities of users and the websites visited by each of the users are recorded in the account data. Therefore, by analyzing the account data, the measure to be realized may be the registration count or registration user number. It is to be noted that some measure cannot be obtained by simply summing the items included in the account data. For example, for the measure of registration user number, it is probable that more than one time of registration is conducted by the same user ID. Since it is allowable to accumulate only one to the registration user number, it is necessary to undergo universal duplication removal.

[0054] In Step 208, whether an attribute in the set of attributes complies with a recursive condition is determined.

[0055] If it is determined that the attribute complies with the recursive condition, execute Step 209.

[0056] If it is determined that the attribute does not comply with the recursive condition, execute Step 210.

[0057] In practice, that the attribute complies with the recursive condition means the element of account data, on which the measure to undergo universal duplication removal relies, has one and only one attribute value regarding the attribute. For example, the element of account data, on which the above-mentioned measure of registration user number relies, is the user ID. In other words, by analyzing identities of users appearing in the account data, the registration user number can be determined. If the attribute is city, a user ID can only correspond to one city. For example, as shown in FIG. 5, the user ID 250708 specifically corresponds to the city "Shenzhen", and the user ID 347516 specifically corresponds to the city "Guangzhou", so the attribute of city complies with the recursive condition. Otherwise, if the element of
account data, on which the measure to undergo universal duplication removal relies, does not have the only attribute value regarding the attribute, the recursive condition is not complied with.

[0058] In Step 209, whether a father attribute among the attributes has a child attribute is determined according to the layer correlation of the attributes.

[0059] If it is determined that the father attribute has a child attribute, execute Step 211.

[0060] If it is determined that the father attribute has no child attribute, execute Step 212.

[0061] For example, in the region dimension, a country includes a plurality of provinces, and a province includes a plurality of cities. Therefore, "city" is a father attribute, "province" is a son attribute of the attribute "city", and "country" is a son attribute of the "province" attribute. Since the father attribute is city, and city is the finest one of the attributes in the layer correlation of attributes, the attribute "city" has no son attribute.

[0062] In Step 210, it is determined that no roll up of the set of attributes is performed according to the attributes,


[0064] Herein, if an attribute in the set of attributes is determined not to comply with the recursive condition, no roll up will be performed according to the attribute. It is because if the element of account data, on which the measure to undergo universal duplication removal relies, does not have the only attribute value regarding the attribute, the removal of the attribute to form the next-layer set of attributes may cause the measure data corresponding to the next-layer set of attributes unable to undergo the duplication removal and accumulation.

[0065] In Step 211, a first strategy is determined as the roll-up strategy.

[0066] The first strategy is adopted to replace the father attribute with the son attribute, and the son attribute constitutes, along with the other attributes in the set of attributes, the next-layer set of attributes. Subsequently, execute Step 213.
In Step 212, a second strategy is determined as the roll-up strategy.

The second strategy is adopted to delete the father attribute, and the next-layer set of attributes is generated with the other attributes in the set of attributes. Subsequently, execute Step 214.

In Step 213, the father attribute is replaced by the son attribute, and the son attribute and the other attributes in the set of attributes form the next-layer set of attributes. After Step 213, go back to Step 204.

In Step 214, the father attribute is deleted, and the other attributes in the set of attributes form the next-layer set of attributes. After Step 214, go back to Step 204.

For example, as shown in FIG. 5, the top-layer set of attributes consists of attributes of city, age and primary source. The registration numbers of the three attributes are acquired. After the first roll up, the attribute of primary source is deleted, and the attributes of city and age form a new set of attributes. The registration numbers of the attributes of city and age are acquired. After the second roll up, the attribute "city" is replaced by the attribute "province", and the attributes of province and age form a new set of attributes. The registration numbers of the attributes of province and age are acquired.

By way of Steps 201-214, a recursive topologic structure is finally acquired. The recursive topologic structure includes a set of attributes and recursive paths among the set of attributes. In practice, a recursive topologic structure can be generated according to the at least one top-layer set of attributes and the information of layer correlation of the attributes at a plurality of nodes respectively corresponding to the at least one top-layer set of attributes.

After a subsequent search request is received, measure data corresponding to an attribute set associated with the search request is recursed according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.

FIG. 6 schematically exemplifies a recursive topologic scheme, which can be generated by directly accumulating measures. The accumulative measures are
registration numbers. The generated top-layer set of attributes in the recursive
topologic structure is determined based on identities and registration websites of users.
The dimension to be analyzed, for example, can be a dimension of region, including
city (hereinafter, Al) and province (hereinafter, A2), and/or a dimension of age, including age number (hereinafter, Bl), and/or a dimension of source, including primary source (hereinafter, Cl). During the generation of the recursive topologic structure, if the same next-layer set of attributes is acquired from different sets of attributes, the next-layer set of attributes needs to undergo duplication removal. In practice, the top-layer set of attributes, for example, is AIBICl. By way of a roll up operation, sets of attributes, e.g. A2B1Cl, A1B1, AlCl and B1C1, can be acquired. Then the set A2B1Cl is further rolled up to acquire sets B1C1, A2B1 and A2Cl. Likewise, by further rolling up the set A1B1, sets A2B1, A1 and B1 can be acquired. By rolling up the set AlCl, sets A2Cl, A1 and CI can be acquired. By rolling up the set B1C1, sets B1 and CI can be acquired. Afterwards, the further roll up of the set A2Blor A2Cl results in A2, and the roll up of Al results in A2 or general attribute ALL. The roll up of B1 results in ALL, and the roll up of CI results in ALL. The subsequent roll up of A2 also results in ALL. Accordingly, if measure data of some sets of attributes are acquired previously, for example the measure data corresponding to A1B1 is previously acquired, the measure data corresponding to A1 and B1 can be directly recursed from the measure data of A1B1.

[0075] FIG. 7 schematically exemplifies a recursive topologic scheme, which is generated by accumulating measures in need of universal duplication removal. The generated top-layer set of attributes in the recursive topologic structure is determined based on identities and registration websites of users. The dimension to be analyzed, for example, can be a dimension of region, including city (hereinafter, Al) and province (hereinafter, A2), and/or a dimension of age, including age number (hereinafter, Bl), and/or a dimension of source, including primary source (hereinafter, Cl). The registration numbers acquired associated with the primary source cannot be simply accumulated because the same user ID may be used for registration of websites
belonging to different attributes of primary source. In other words, a user ID under a specified primary source attribute may correspond to different primary source attributes. Therefore, the attribute CI cannot be used to generate the recursive topologic structure. During the generation of the recursive topologic structure, if the same next-layer set of attributes is acquired from different sets of attributes, the next-layer set of attributes needs to undergo duplication removal. In practice, the top-layer set of attributes, for example, is A1B1C1. By way of a roll up operation, sets of attributes, e.g. A2B1C1, AlCl and B1Cl, can be acquired. Then the set A2B1C1 is further rolled up to acquire sets B1Cl and A2C1. Since the attribute CI cannot be used to generate the recursive topologic structure, the attribute AlBl needs to be acquired from the account data. By rolling up the set AlCl, sets A2C1 and CI can be acquired. By rolling up the set B1Cl, set CI can be acquired. Afterwards, the further roll up of the set A2B1 results in A2, and the roll up of A1 results in A2 or general attribute ALL. The roll up of B1 results in ALL, and the roll up of CI results in ALL. The subsequent roll up of A2 also results in ALL. Accordingly, if measure data of some sets of attributes are acquired previously, for example the measure data corresponding to AlBl is previously acquired, the measure data corresponding to A1 and B1 can be directly recursed from the measure data of AlBl. As shown in FIG. 7, A1B1C1 and AlBl are two top-layer sets of attributes, and recursive topologic structures of A1B1C1 and AlBl are generated at two nodes, respectively. Two recursive topologic structures are separately maintained at the two nodes. If the attributes contained in the top-layer set of attributes, the same recursive topologic sub-tree may also split at a plurality of nodes for maintenance.

[0076] It is to be noted that a main body executing the multidimensional data processing method provided according to the another embodiment of the present invention can be a multidimensional data processing device. The multidimensional data processing device can be operated in, but not limited to, an electronic equipment such as a computer or a network server.

[0077] In the multidimensional data processing method provided according to the
another embodiment of the present invention, since a recursive topologic structure is generated according to the at least one top-layer set of attributes and the information of layer correlation of the attributes, wherein the recursive topologic structure includes a set of attributes and recursive paths among the set of attributes. Therefore, when a search request is received, measure data corresponding to an attribute set associated with the search request can be recursed according to the recursive paths and a specified measure data corresponding to a previously specified attribute set. In contrast, according to prior art, when measure data corresponding to an attribute set is required, it is necessary to acquire measure data associated with a variety of dimensional attribute sets from the account database, so the computation is relative complicated. In the present invention, measure data corresponding to unknown attribute sets can be realized according to the recursive topological structure and a specified measure data corresponding to a previously specified attribute set, thereby simplifying the computation.

[0078] A multidimensional data processing device provided according to an embodiment of the present invention as shown in FIG. 8, which corresponds to the embodiment of multidimensional data processing method illustrated in FIG. 2 and FIG. 3, includes the following units.

[0079] An acquisition unit 31 acquires information of dimensions, information of attributes in each of the dimensions and information of layer correlation of the attributes from a data business.

[0080] The acquisition unit 31 further realizes a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes.

[0081] A generation unit 32 generates at least one top-layer set of attributes according to the finest one of the attributes in each of the dimensions.

[0082] The generation unit 32 further generates a recursive topologic structure according to the at least one top-layer set of attributes and the information of layer correlation of the attributes. The recursive topologic structure includes a set of
attributes and recursive paths among the set of attributes.

[0083] A recursion unit 33 receives a search request, and recurses measure data corresponding to an attribute set associated with the search request according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.

[0084] In practice, referring to FIG. 9, the generation unit 32 includes:

- a discrimination module 321 determining whether the set of attributes are general attributes or not; and
- a generation module 322 conducting roll-up of the set of attributes to generate a next-layer set of attributes if the set of attributes are not general attributes.

[0085] In practice, referring to FIG. 9, the generation module 322 includes:

- a traverse sub-module 3221 traversing each attribute in each set of attributes;
- an acquisition sub-module 3222 realizing each condition to be complied with for the each attribute;
- a determination sub-module 3223 determining a roll-up strategy of the set of attributes according to the each condition to be complied with for the each attribute; and
- a generation sub-module 3224 conducting roll-up of the set of attributes to generate the next-layer set of attributes according to the roll-up strategy.

[0086] In practice, the acquisition sub-module 3222 further determines whether the measure corresponding to the set of attributes needs to undergo universal duplication removal.

[0087] Furthermore, as shown in FIG. 9, the acquisition sub-module 3222 further determines whether an attribute in the set of attributes complies with a recursive condition or not if it is determined that the measure corresponding to the set of attributes needs to undergo universal duplication removal.

[0088] In practice, referring to FIG. 9, the determination sub-module 3223 further determines not to conduct roll-up of the set of attributes according to the attributes if it
is determined no attribute in the set of attributes complies with the recursive condition.

Furthermore, referring to FIG. 9, the acquisition sub-module 3222 further determines whether a father attribute among the attributes has a child attribute according to the layer correlation of the attributes if it is determined no measure needs to undergo universal duplication removal or it is determined an attribute in the set of attributes complies with the recursive condition.

Furthermore, referring to FIG. 9, the determination sub-module further determines a first strategy as the roll-up strategy if it is determined a father attribute has a child attribute, wherein according to the first strategy, the child attribute replaces the father attribute to constitute, along with the other attributes in the set of attributes, the next-layer set of attributes, and determines a second strategy as the roll-up strategy if it is determined the father attribute has no child attribute, wherein according to the second strategy, the father attribute is deleted, and generating the next-layer set of attributes with the other attributes in the set of attributes.

In practice, referring to FIG. 9, the generation unit 32 generates a recursive topologic structure according to the at least one top-layer set of attributes and the information of layer correlation of the attributes at a plurality of nodes respectively corresponding to the at least one top-layer set of attributes.

In the multidimensional data processing device provided according to an embodiment of the present invention, since a recursive topologic structure is generated according to the at least one top-layer set of attributes and the information of layer correlation of the attributes, wherein the recursive topologic structure includes a set of attributes and recursive paths among the set of attributes. Therefore, when a search request is received, measure data corresponding to an attribute set associated with the search request can be recursed according to the recursive paths and a specified measure data corresponding to a previously specified attribute set. In contrast, according to prior art, when measure data corresponding to an attribute set is required, it is necessary to acquire measure data associated with a variety of dimensional attribute sets from the account database, so the computation is relative complicated. In
the present invention, measure data corresponding to unknown attribute sets can be realized according to the recursive topological structure and a specified measure data corresponding to a previously specified attribute set, thereby simplifying the computation.

[0093] According to the above descriptions of embodiments, those skilled in the art are able to clearly understand that the invention can be implemented with software and essential hardware. Hardware may also be used to implement the invention even though the combination of software and hardware would be preferred. Accordingly, the technical solution according to the present invention as well as the contribution relative to the prior art is basically the software part. The software product of computer is stored in an accessible storage medium, e.g. floppy disc, hard disc or optical disc of a computer. A plurality of commands are used to have a computer device, e.g. personal computer, server or network equipment, execute the methods according to the embodiments of the present invention.

[0094] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.
WHAT IS CLAIMED IS:

1. A multidimensional data processing method, comprising:
   realizing information of dimensions, information of attributes in each of the
dimensions and information of layer correlation of the attributes from a database;
   realizing a finest one of the attributes in each of the dimensions according to the
information of dimensions, information of attributes in each of the dimensions and
information of layers of the attributes;
   generating at least one top-layer set of attributes according to the finest one of
the attributes in each of the dimensions;
   generating a recursive topologic structure according to the at least one top-layer
set of attributes and the information of layer correlation of the attributes, the recursive
topologic structure including a set of attributes and recursive paths among the set of
attributes; and
   receiving a search request, and recursing measure data corresponding to an
attribute set associated with the search request according to the recursive paths and a
specified measure data corresponding to a previously specified attribute set.

2. The multidimensional data processing method according to claim 1, wherein
generating a recursive topologic structure according to the at least one top-layer set of
attributes and the information of layer correlation of the attributes includes:
   determining whether the set of attributes are general attributes or not; and
   conducting roll-up of the set of attributes to generate a next-layer set of
attributes if the set of attributes are not general attributes.

3. The multidimensional data processing method according to claim 2, wherein
conducting roll-up of the set of attributes to generate a next-layer set of attributes
includes:
   traversing each attribute in each set of attributes;
   realizing each condition to be complied with for the each attribute;
determining a roll-up strategy of the set of attributes according to the each condition to be complied with for the each attribute; and
conducting roll-up of the set of attributes to generate the next-layer set of attributes according to the roll-up strategy.

4. The multidimensional data processing method according to claim 3, wherein realizing each condition to be complied with for the each attribute includes:
determining whether a measure corresponding to the set of attributes needs to undergo universal duplication removal.

5. The multidimensional data processing method according to claim 4, wherein realizing a condition to be complied with for the each attribute includes:
determining whether an attribute in the set of attributes complies with a recursive condition if it is determined the measure corresponding to the set of attributes needs to undergo universal duplication removal.

6. The multidimensional data processing method according to claim 5, wherein determining a roll-up strategy of the set of attributes according to the condition to be complying with for the each attribute includes:
determining not to conduct roll-up of the set of attributes if it is determined no attribute in the set of attributes complies with the recursive condition.

7. The multidimensional data processing method according to claim 5, wherein realizing each condition to be complied with for the each attribute includes:
determining whether a father attribute among the attributes has a child attribute according to the layer correlation of the attributes if it is determined no measure needs to undergo universal duplication removal or it is determined an attribute in the set of attributes complies with the recursive condition.

8. The multidimensional data processing method according to claim 6, wherein determining a roll-up strategy of the set of attributes according to the condition to be complied with for the each attribute further includes:
determining a first strategy as the roll-up strategy if it is determined a father
attribute has a child attribute, wherein according to the first strategy, the child
attribute replaces the father attribute to constitute, along with the other attributes in
the set of attributes, the next-layer set of attributes; and
determining a second strategy as the roll-up strategy if it is determined the father
attribute has no child attribute, wherein according to the second strategy, the father
attribute is deleted, and generating the next-layer set of attributes with the other
attributes in the set of attributes.

9. The multidimensional data processing method according to any of claims 1-8,
wherein generating a recursive topologic structure according to the at least one
top-layer set of attributes and the information of layer correlation of the attributes
includes:
generating a recursive topologic structure according to the at least one top-layer
set of attributes and the information of layer correlation of the attributes at a plurality
of nodes respectively corresponding to the at least one top-layer set of attributes.

10. A multidimensional data processing device, comprising:
an acquisition unit realizing information of dimensions, information of attributes
in each of the dimensions and information of layer correlation of the attributes from a
database;
wherein the acquisition unit further realizes a finest one of the attributes in each
of the dimensions according to the information of dimensions, information of
attributes in each of the dimensions and information of layers of the attributes;
a generation unit generating at least one top-layer set of attributes according to
the finest one of the attributes in each of the dimensions;
wherein the generation unit further generates a recursive topologic structure
according to the at least one top-layer set of attributes and the information of layer
correlation of the attributes, the recursive topologic structure including a set of
attributes and recursive paths among the set of attributes; and
a recursion unit receiving a search request, and recursing measure data
corresponding to an attribute set associated with the search request according to the recursive paths and a specified measure data corresponding to a previously specified attribute set.

11. The multidimensional data processing device according to claim 10, wherein the generation unit includes:

   a discrimination module determining whether the set of attributes are general attributes or not; and
   
   a generation module conducting roll-up of the set of attributes to generate a next-layer set of attributes if the set of attributes are not general attributes.

12. The multidimensional data processing device according to claim 11, wherein the generating module includes:

   a traverse sub-module traversing each attribute in each set of attributes;
   an acquisition sub-module realizing each condition to be complied with for the each attribute;
   
   a determination sub-module determining a roll-up strategy of the set of attributes according to the each condition to be complied with for the each attribute; and
   
   a generation sub-module conducting roll-up of the set of attributes to generate the next-layer set of attributes according to the roll-up strategy.

13. The multidimensional data processing device according to claim 12, wherein the generation sub-module determines whether a measure corresponding to the set of attributes needs to undergo universal duplication removal.

14. The multidimensional data processing device according to claim 13, wherein the acquisition sub-module further determines whether an attribute in the set of attributes complies with a recursive condition if it is determined the measure corresponding to the set of attributes needs to undergo universal duplication removal.

15. The multidimensional data processing device according to claim 14, wherein the determination sub-module determines not to conduct roll-up of the set of attributes if it is determined no attribute in the set of attributes complies with the
recursive condition.

16. The multidimensional data processing device according to claim 14, wherein the acquisition sub-module further determines whether a father attribute among the attributes has a child attribute according to the layer correlation of the attributes if it is determined no measure needs to undergo universal duplication removal or it is determined an attribute in the set of attributes complies with the recursive condition.

17. The multidimensional data processing device according to claim 15, wherein the determination sub-module further determines a first strategy as the roll-up strategy if it is determined a father attribute has a child attribute, wherein according to the first strategy, the child attribute replaces the father attribute to constitute, along with the other attributes in the set of attributes, the next-layer set of attributes, and determines a second strategy as the roll-up strategy if it is determined the father attribute has no child attribute, wherein according to the second strategy, the father attribute is deleted, and generating the next-layer set of attributes with the other attributes in the set of attributes.

18. The multidimensional data processing device according to any of claims 10-17, wherein the generation unit generating a recursive topologic structure according to the at least one top-layer set of attributes and the information of layer correlation of the attributes at a plurality of nodes respectively corresponding to the at least one top-layer set of attributes.
**FIG. 1**

Realize information of dimensions, information of attributes in each of the dimensions and information of layer correlation of the attributes from a database

Realize a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes

Generate at least one top-layer set of attributes according to the finest one of the attributes in each of the dimensions

Generate a recursive topologic structure according to the at least one top-layer set of attributes and the information of layer correlation of the attributes

Receive a search request, and recurse measure data corresponding to an attribute set associated with the search request according to the recursive paths and a specified measure data corresponding to a previously specified attribute set

**FIG. 2**
Acquire account data of a data business, information of dimensions in the data business, information of attributes in each of the dimensions and information of layer correlation of the attributes

Realize a finest one of the attributes in each of the dimensions according to the information of dimensions, information of attributes in each of the dimensions and information of layers of the attributes

Generate at least one top-layer set of attributes according to the finest one of the attributes in each of the dimensions

Traverse each set of attributes, and determine whether the set of attributes to be rolled up are general attributes or not

Determine that no further roll-up of the set of attributes is available

Determine whether a measure corresponding to the set of attributes needs to undergo universal duplication removal

Determine whether an attribute in the set of attributes complies with a recursive condition

Determine a second strategy as the roll-up strategy

Delete the father attribute, and form the next-layer set of attributes with the other attributes in the set of attributes

Determine a first strategy as the roll-up strategy

Replace the father attribute by the son attribute, and form the next-layer set of attributes with the son attribute and the other attributes in the set of attributes

Determine that no roll up of the set of attributes is performed according to the attributes

FIG. 3
FIG. 4
Account data

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Top-layer set of attributes: City-Age-Primary source

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<th>Age</th>
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Next-layer set of attributes: City-age

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Next-layer set of attributes: Province-age

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FIG. 5
INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/084506

A. CLASSIFICATION OF SUBJECT MATTER
G06F 17/30(2006.01)i

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)
G06F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPI, EPDOC, CNPAT, CNKI, IEEE: multi w dimension+, multidimension+, hyperspatial, top. layer, hierarchial, recurs+, data, process+, attribute?, field

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  "A" - document defining the general state of the art which is not considered to be of particular relevance
  "E" - earlier application or patent but published on or after the international filing date
  "L" - document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" - document referring to an oral disclosure, use, exhibition or other means
  "P" - document published prior to the international filing date but later than the priority date claimed

  "Y" - later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" - document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" - document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "G" - document member of the same patent family

Date of the actual completion of the international search 31 October 2014
Date of mailing of the international search report 19 November 2014

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