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METHOD AND SYSTEM FOR COMPUTERIZED MANAGEMENT OF RELATED DATA RECORDS

FIELD OF THE INVENTION

This invention relates to methods and systems for computerized management of data records, and in particular, to computer-based identification and management of related data records.

BACKGROUND OF THE INVENTION

Computerized management of related data records may be applied in different fields as, for example, genealogy and investigation of family history, catalog data management, document versions management, circuits and/or software testing management and other applications.

The problems of management of related data records as well as corresponding family-tree generation have been recognized in the art and various systems and methods have been developed to provide a solution, for example:

US Patent No. 6,665,677, to Wotring et al, describes a system and method for transforming a relational database to a hierarchical database. The invention comprises a computer-implemented method for transforming data in a relational database to a hierarchical database. It comprises creating an import map that maps each relational database field to a hierarchical field in the hierarchical database using a relational database schema and a hierarchical database schema, using the import map to import data from the relational database; and transforming the relational data into hierarchical documents. The method further comprises creating a hierarchical database schema that corresponds to the relational database schema. The hierarchical documents may be stored in computer memory or on disk.

US Patent No. 6,742,001 to Ripley, describes a system and method for sharing data between hierarchical databases. The computer-implemented system and method described therein allow data from a first hierarchical data structure to be applied to a second hierarchical data structure. The method comprises recursively comparing the source elements of the first hierarchical structure to the target elements of the second hierarchical structure, and applying the data from a source element or source child

element to a matching target element or target child element. The method is iterated, until all elements of the second hierarchical data structure have been traversed.

US Patent No. 6,760,731, to Huff, describes a worldwide genealogy data storage and retrieval system for implementation on the internet, wherein genealogical data from every source can be collected, reviewed, revised, extended, consolidated, summarized, indexed, lineage-linked, and displayed. The invention further relates to a method and apparatus for cooperative publishing and distribution of genealogical data. The invention allows owners of lineage-linked genealogical data to publish the data in any size increments and for buyers to select and retrieve any number of names and associated data. An integrated micropayment system requires users of the data to make payments for each increment of data received, and royalties are paid to the owners of the data from these payments.

US Patent No. 6,910,044, to Weinberg, *et ah,* entitled "Method and apparatus for structuring, mamtaining, and using families of data" discloses a method and apparatus for structuring, maintaining, and using families of data. According to the invention disclosed by Weinberg, *et ah,* given one or more sets of partitioning data, one may construct a set of families based on the values of fields and attributes of the records in a database system. The families are stored and managed in separate tables. The records in data tables are identified as belonging to one or more families, while families may be represented in a hierarchical structure. Families may also inherit from each other based on a parent to child relationship also stored in the database.

JUS Patent No. 7,047,202 to Jaipuria et al., describes a method and apparatus for optimizing networking potential using a secured system for an online community. The system allows for users to search networks, both their own network and their peers' networks, all under the umbrella of a "multiple level access" security system. The present invention has been designed to optimize networking capabilities among users in a comprehensive online community. Networking among such a secured environment will allow users an opportunity to enhance their networking potential by expanding their networks to their peers' and beyond. A user registers with the online community and personally adds individuals that they know to their personal networking database. While adding these peers to the networking database, the user grants a specific level of access to each individual. This security measure is devised to discourage solicitation from other unwanted online users. The levels of access give the user an opportunity to control

the amount of personal information, including contacts that they make, available to their individual peers. Based on the level of access granted by the user, the peer may or may not be able to access the users' information or the user's personal databases for potential networking. The level of access granted by two individuals need not be the same for each other.

US Patent Application No. 2002/032687, to Huff, entitled "Genealogy registry system" discloses a genealogy data storage and retrieval system for implementation on the Internet, wherein genealogical data from different sources can be collected, reviewed, revised, extended, consolidated, summarized, indexed, lineage-linked, and displayed.

US Patent Application No. 2003/14422 (Notargiacomo *et al.)* entitled "Method and system for building a family tree" discloses a method, system and computer software product for gathering information relevant to the creation of a family tree. Searching of multiple databases is done through a communication network for obtaining relevant information and assessing the probability that the newly identified individual is related to the original individual.

US Patent Application No. 2005/149497 (Cookson *et al.)* entitled "Genealogical investigation and documentation systems and methods" discloses a method of creating a family tree, the method includes receiving a request from a user to return a file that includes the family tree and using a plurality of primary source records to construct the family tree based on the request, wherein the records may indicate multiple alternatives for at least one branch of the family tree.

French Patent Application No. 2814563 (Hergault) entitled "Method allowing genealogy database users to exchange genealogy information over the Internet" discloses a method involving extraction of statistical information from databases comprising genealogy information, transmission of statistical information to a server-router, transmission of a request from an end-user, server comparison of request to the statistical information, transmission of the request from the server to a number of users, transmission of genealogy data from end-users to the requesting end-user via the Internet.

SUMMARY OF THE INVENTION

The present invention is directed to methods, systems and computer program products for computerized consolidation of data records among plurality of data records, each data record comprising at least one sub-record assigned to a corresponding object.

Thus, by a first aspect the present invention provides a method for computerized consolidation of data records among plurality of data records, each data record comprising a main record on a first object and at least one sub-record assigned to a second object related to the first object, the method comprising: (a) comparing a first data record with one or more second data records; and (b) consolidating the first data record and at least one of the second data records responsive to determining a match between comparative data items in the first and second data records, said comparative data items comprising data from one or more such sub-records.

Thus, by the method of the invention the first data record and the second data records are processed; the match between some or all of the comparative data items is determined; and responsive to determining a match of one or more comparative data items the first data record is consolidated with one or more second data record. The comparative data items are typically a sufficient number of such data items so that either the majority of the comparative data items or a number sufficient so as to make it probable - according to pre-defined criteria - that the first and the second data items match one another.

The comparative data items may include the entire sub-records or may include a characteristic or representative part thereof. A characteristic or representative part may include one or more values or data bit that define the sub-record. For example, where said first object is a first person and said one or more second objects are one or more second persons related in some way to the first person, in accordance with a preferred embodiment to be described below, a characteristic part of the sub-record may be the second person's name, address, profession, etc. At times the comparative data items may include all of the respective sub-records.

The term "match" should be understood to signify identity of comparative data records; or to signify that two matching comparative data records, albeit not identical, are similar so as to relate to the same data record with a high degree of probability. For example, in the case the comparative data record is a name of an individual, for instance

and individual named Josef, a similar data may relate to an individual by the name of Joe, Yosef, Yossi, etc.

The term "object" should be understood to relate both to a physical entity, such as an individual, a piece of merchandise, and others, as well as to a virtual entity such as an electronic record or document, a software, etc. The term "object" relates, according to a particular example of a preferred embodiment of the invention, to personal data items on an individual and the data record includes the family tree of that individual. According to such preferred embodiment the main record is personal data on said individual and the sub-records comprise data pieces relating to individuals included in the family tree. In accordance with this embodiment, the method and system of the invention are used for merging of related family trees. Related family trees include family trees with overlapping data, according to defined criteria. The merging of family trees according to this embodiment generates a consolidated family tree from one or more *a priori* separated ones. In accordance with an embodiment of the invention a comparative set of data items is generated for each data record, e.g. personal data record, and the consolidation occurs in case of identity of sufficient number, at times the majority, of comparative data items in the comparative set, between the two data records. The comparative data set may be represented in a linear or a two dimensional array of comparative data items. For example, the comparative data set may be represented as a computer-generated string sequence comprising a predefined set of building blocks, e.g. organized hi predefined sequence order. The number of matching building blocks between two data records can determine the probability of match between the two data records. By one embodiment, the sub-records in the comparative data set comprise names of persons related to the first person. For examples, where the building blocks of the comparative data set include data on relatives, two personal data records that with a comparative data set including names of parents and grandparents, let say, cannot be regarded as matching records with high probability, as the same identifiers may also be applicable to siblings. Other matching data items in the comparative data set, for examples names of siblings, may increase the probability of match between different personal data records.

The method of the invention is useful for a variety of other applications in which a multiple data records may exist that relate to the same object. Examples of such data records are: different version of the same document in a computer network, where the

first object is the document and the one or more second objects being attributes such as the time of creation, the time modifications were made, the subject, the author, etc.; different versions of the same software in a computer network, e.g. a software in development where the different version were created as a result of different inputs be different software developers, where the first object is the software and the one or more second objects being attributes such as the time of creation, the time modifications were made, the subject, the identity of the development team, the project code, etc.; multiple copies data records on inventories, where the first object is the stored item and the one or more second objects may be attributes, such as product nature, manufacturer, time of manufacture, origin, destination, etc. A typical, albeit not exclusive application of the invention is in a case where different computer or network users may enter or edit said data records. Examples are: data records on results of scientific experiments where different scientists or research assistants may input the data, at times scientist or research assistants at different locations, where the first object is the nature of the experiment and the one or more second objects may be the experimenter, the laboratory where the experiment was done, reagents origin, name of experimenter, etc.; data records on a joint project, where the first object is a description of the project and the one or more second objects may include description of sub-assignments, project participants, target completion date, etc..

The terms "consolidation", "consolidating", etc., refers to combining, uniting or fusing data records to form one consolidated data record. The consolidation may involve updating a first data record with data contained in the one or more second data records, or *vice versa;* or may involve providing a link in one or both of the consolidated data records to data in the other or making reference to such data in one or both of the data records to the other data record; or any other solution that will give rise to essentially or substantially combining the consolidated records into one. It should be noted that in the case, for example, where the two consolidated data records are included originally in different data bases, the consolidated data records may still have separate, albeit identical entries in the two databases.

According to an embodiment of the invention, said consolidating occurs following matching of comparative data items comprising, for example, at least five, at times at least six, occasionally at least seven and often at least eight items. According to some embodiments of the invention each of the different items among the comparative

data items has the same weighting factor for determining a match. According to other embodiments of the invention different such data items may have different weighting factors for determining a match. In the latter case, a match may be determined not on the basis of the number of said data items but rather, for example, on the basis of a total or average weighting factor of data items.

According to some embodiments, the matching makes use of a phonetic algorithm. This may be important in cases where data may be input in different manners, such as in the case of data records which are personal data records (to be discussed below).

The consolidation of the data records is carried out on the basis of matching of a comparative data set that includes one or more data items, typically data items of sub-records. The comparative data items may include the entire sub-record or may include a selected, typically identifying-portion out of the sub-record.

According to some embodiments of the invention the consolidation involves determining probability that said first and said second data records are identical on the basis of the number or another value (e.g. cumulative or average weighting factor) relating to comparative data items in the two records, and then consolidating said first and second data records where said probability exceeds a predetermined level.

The method of the invention is applicable both where the first and the second data records are included in the same database as well as in the case where the data records to be consolidated are included in different databases, for example databases that are intended to be merged with one another.

Typically, the comparative data items may be represented as a data set comprising a matrix of data items. The matrix may be one-, two- or multi-dimensional arrangement of data items. A linear matrix may consist of a predefined sequence of comparative data items. For example: where the object is an electronic document, the predefined sequence may consist of a series of comparative data items listed in a predefined order that relate to the document's nature, originator, date of creation, etc.; where the object is a person, the comparative data set may consist of a predefined order of comparative data items that may include, for instance, a name of other individuals with a predefined relationship with the person, arranged in a predefined order.

The method of the invention is typically carried out over a computer network, e.g. the Internet.

A preferred embodiment of the invention is the case were said object is a person, said data record is a personal data record, said main record is data record on person and the sub-records are data on other persons relating to the first one.

In accordance with this preferred embodiment there is thus provided a method for computerized consolidation of personal data records among plurality of personal data records, each of said data record comprising a main record on a first person and at least one sub-record assigned to a second person that is related to the first person, the method comprising: (a) comparing a first personal data record with one or more second personal data records; and (b) consolidating the first data record and at least one of the second data records responsive to determining a match between comparative data items in the first and second data records, said data items comprising data from one or more of said sub-records. In accordance with some particularly preferred embodiments one or both of the first or the second personal data records are in a form of a family tree database. The term "family tree" should be construed in a broad sense as relating to a data base of a plurality of persons and at least some of their familial relationship. The family tree may be represented graphically in one of many different graphical representation means of such information; may be stored as data records within a computer system or stored in a manner that enables to reconstruct the data record, for example from multiple distributed data pieces (the data record including at least one identifier for each person and one or more family relationships to one or more other individuals in the family tree); or both. A family tree may also be thought of as a graph (which may be graphically represented or virtually represented within a computer system) in which connecting lines represent the family relationships and the nodes represented the persons of the family tree (to be referred to herein at times as "nodes"). See also the definition further below.

In accordance with a further preferred embodiment, the consolidation further comprises merging a first family tree data record with one or more second family trees data records to generate a merged family tree. The consolidation may further comprise consolidating multiple nodes in two or more merged family trees, each node representing a personal data record.

By one embodiment the invention provides a method for computerized management of a plurality of family trees, each family tree having a plurality of nodes, each of which represents a first person with associated personal data record, the method

comprising: for each personal data record, assigning one or more sub-records to one or more second persons relating to said first person, the sub-records comprising data on the second persons and their relationship to the first person; comparing the personal data records with the personal data records from the plurality of family trees and identifying at least two trees that comprise each a predefined number of common nodes that represents the same individuals, the identification comprises determining existence of matching comparative data items in the personal data records associated with the nodes, the comparative data items comprising data from one or more sub-records; and merging said at least two trees with one another to yield a merged family tree which comprises at least some of the nodes common to said at least two trees. At times, for the purpose of merging two or more family trees a plurality (2, 3, 4, 5 or more) of common nodes may be required.

Each person may be a member in different capacities in different family trees. For example, a person A may be included in one family tree of a person B by marriage to a 'blood' relative of person B; person A may also included as a 'blood' relative, e.g. a grandchild of a family tree of another person C. The consolidation of the personal data records of such a person included in two or more family trees, allows the merging of such *apriori* separate family trees into one big family tree.

In some examples, the comparative data items of the first and/or the second personal data record are in a form of a graphical display of a family tree. In such a case pattern recognition algorithms may be employed as part of the data record consolidation procedure.

The merging of the family trees may include the process of importing, exporting, transforming and/or superimposing .that may involve: (a) merging a database record in the first family tree with a graphical display record in the one or more second family trees; (b) merging personal data records from two or more family trees; (c) merging a graphical display record in the first family tree with a graphical display record in one or more other family trees; (d) consolidating person-indicating nodes comprised in the first family tree with person-indicating nodes in the one or more second family trees; and others.

In accordance with one embodiment of the invention the comparative data items are represented as one or more sequences or strings of data pieces. According to this embodiment there is thus provided a method for computerized management of at least

two family trees, each family tree being identified by a plurality of relationship sequences, the method comprising: identifying at least one first family tree of said at least two family trees having at least one matching sequence with at least one second family tree of said at least two family trees; and merging said at least one first family tree to said at least one second family tree into one consolidated family tree.

According to one embodiment, the data sequence consists of data pieces relating to an individual included in the family tree, the position of the data piece in the sequence being predetermined based on familial relationship. A data piece relating to an individual may be the individual's name or any other personal attribute. A sequence of data pieces may thus include, for example, a sequence of names of individuals included in the family tree, their position in the sequence being identified by their relationship to the person X whose family tree it is. An exemplary, non-limiting sequence is one such as person X - father of X - mother of X - brother of X - sister of X - grandfather of X – ...

A family tree is a relationship network in which the individuals are the nodes and the relationships are connecting lines between them. The term "nodes" should be understood to denote individuals represented in the family trees. The term "connecting lines" should be understood to denote a representation of relationships between individuals. For example, a single line connecting two nodes represents a first degree family relationship - between a parent and a child, between two siblings and between two members of a couple (e.g. husband and wife). A second degree relationship, e.g. between one individual and an uncle/aunt or between one individual and a brother/sister-in-law, between a grandparent and a grandchild, etc., will be represented by a two-segment connecting line going through another node. For example, for an individual-uncle a two-segment connecting line will include a first segment from the individual to his/her parent and a second line from the parent to a sibling of the parent. It should be understood that the terms "node" and "connecting lines" are functional terms and should not be construed in a descriptive or graphical sense. While a family tree may be represented as such nodes with connecting lines, it may also, by other embodiments, be represented in the form of a table of data fields, or may be graphically represented in any other form.

According to an embodiment of the invention, said data sequences include pieces of the network data, namely nodes and connecting lines. At minimum such

sequences include each a pair of nodes and the connecting line between them. For example a pair of nodes representing: parent - child; first sibling -second sibling; person - spouse. Such a sequence may also include more than two nodes and more than one connecting line. For example, sequences such as: Grandparent - child - grandchild; child - parent - uncle/aunt; person —sister - brother-in-law; child - parent - parent's child from another marriage; father - son - daughter-in-law (DIL) - DIL father; etc. For two family trees to merge, the matching sequences should be sufficient to determine a match between the two family trees with a sufficiently high probability. A sufficiently high probability may be defined by an optimized minimal number of matching nodes and possibly also their weighting factor. A weighting factor may take into account, for example, the family distance (degree of relationship) between the data-entering individual and the individual who is represented by a certain node (seeing that the accuracy of the data on an individual may diminish with increasing relationship distance between a data-entering individual and the individuals regarding whom data was input). The weighting factor may also take into consideration the scarceness of a certain data item (e.g. a very rare name may get a high weighting factor). Thus, typically for a match between two family trees to be determined and for the trees to thus merge, the matching sequences should include a number of common nodes which are not less than a certain pre-determined number, and/or a minimum number of pairs of directly connected nodes. For example, the minimum number of pairs of nodes to determine a match may be 2, 3, 4, 5, 6, 7, 8, 9, or 10 (the minimum number depending, among others, on the weighting factor).

According to an embodiment, the family tree-merging process between a first family tree and a second family tree comprises converting each of the family trees into a plurality of matrices, each of which consists of attributes of at least two individuals linked to one another by a predetermined link, including: a direct link, e.g. parent-sibling, husband-wife; or indirect ling such as sibling1-sibling 2 (connected through a parent), grandparent-grandchild, etc. The attributes may be arranged in a predefined linear sequence. Also, each attribute may be given a numerical value to thereby define a vector in a 2-, 3- or multi-dimensional space. Thus a plurality of first matrices, sequences or vectors associated with the first family tree and a plurality of second matrices, sequences or vectors associated with the second family tree are thereby generated. The family tree-merging process then comprises locating a minimal number

of substantially identical matrices, sequences or vectors in the two family trees. The term "substantially identical" should be understood as also encompassing the situation of identity as well as substantial identity, namely a slight mismatch that does not change the property of the two matrices or vectors of being identical. This is the case, for example, where a certain attribute (e.g. name of a father) is missing from one of the two family trees but included in the other. Additionally, a probability of identity factor may be added and factored-in in determining a match between family trees.

Typically, each such matrix consists of two individuals that are directly connected to one another, each with a minimal number of attributes that define the individual. By way of example, such attributes may consist of name of the individual, name of mother and name of father, in a predefined order. A corresponding matrix or vector may include these attributes for each of two directly connected individuals, typically arranged in a pre-defined order. In case of a family tree including a person A who is a father of person B, a vector may be constructed from the numerical values given to each of the attributes in the sequence: name of A - name of father of A - name of mother of A - name of B - name of father of B (which in this case is A) - name of mother of B; etc. A match between the first family tree and the second family tree may be defined where the two contain a minimal, predefined number of identical vectors that defines a match with a high degree of probability. The minimal number may depend on a number of factors including, for example: a definition of an acceptable level of a false positive result; on cultural or society-dependent factors, e.g. in dependence on name-usage patterns (in societies are cultures where a wide variety of different names are used, the minimal numbers of vectors to define a match may be low; where a society is characterized by repetitive use of the same names in a family the minimal number may be high). The minimal number of matching vectors to define a match will typically be 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15.

It is to be noted, by way of example only, that a family tree that includes a grandfather A, and grandmother B, their siblings C and D, respective spouses E and F and respective children G and H and I and J, may yield vectors of individuals and their attributes in as follows (or *vice versa):* A-B, A-C, A-D, B-C_5B-D, C-E, D-F, C-G, C-H, E-G, E-H, D-I, D-J, F-I, F-J.

The merging process may be automatically initiated at the computer system upon determination of a match; or may be a user-initiated process, for example after a

computer prompt. Additionally, the merge upon a match may occur automatically within the computer and be made visible (e.g. graphically displayed) to the user only upon user initiation. A merged family tree may be graphically represented as such to a user in a variety for different graphical representation means; a user may be permitted to navigate, by one of a variety of navigation tools, from one merged family free to another, through junctions between different family trees, the junctions being formed by one or more consolidated personal data records; a user may be provided with means to display sequences of the merged family trees; etc.

The merged personal records may at times be originally included in the same database, or may at time be originally included in separate databases, e.g. databases that are consolidated with one another.

By another of its aspects, the present invention provides a method for merging a first family tree to a second family tree, comprising: providing a plurality of first matrices associated with the first family tree and a plurality of second matrices associated with the second family tree, each matrix comprising attributes on individuals that are linked to one another by a predetermined link; identifying substantially identical first and second matrices in said pluralities of first and second matrices; and generating data indicative of a merge of the family trees to one another if a number of the substantially identical matrices exceeds a predefined number.

The data indicative of the merge may include a note to the user that the match has been determined and a merged tree can be or have been created, or may include data indicative of the merged tree itself.

Each matrix may include attributes on individuals with a direct family link. The attributes may be arranged in a predefined linear sequence. Each attribute may be given a numerical value so as to define a vector for each sequence and step (b) comprise searching for substantially identical first and second vectors.

By yet another of its aspects the present invention provides a system for computerized consolidation of data records among plurality of data records, each of the data records comprising a main record on a first object and at least one sub-record assigned *to* a second object related to the first object, the system comprising: a processor utility configured to process data indicative of said data records, to determine a match between one or more comparative data items each of which consisting of a sub-record or comprising a characteristic part of a sub-record, and (iii) responsive to

deteraiining the match of one or more comparative data items, generating data indicative thereof enabling consolidating the first and the one or more second data items; and a storage utility for storing the consolidated data records.

The system in accordance with a preferred embodiment is intended for computerized consolidation of personal data records among plurality of personal data records, each of the personal data record comprising a main record on a first person and at least one sub-record assigned to a second person related to the first person.

The system according to this embodiment for computerized management of at least two family trees, each of which being identified by a plurality of relationship sequences, comprises: a computer system configured as a server system accessible by users of a computer network through a client-server communication session, comprising a memory utility for storing a database relating to family trees, a first processor utility for constructing family trees on the basis of data stored in said database and a second processor utility for searching and identifying in at least two family trees at least one matching sequence and merging said at least two family trees into one consolidated family tree.

The system of the invention is useful for carrying out the method as described herein.

The invention also provides a computer program product comprising a computer readable medium having computer readable program code embedded therein for causing the computer to perform the method as described and defined herein.

Also provided by a further aspect of the invention is a program storage device readable by machine, tangibly embedded therein a program of instructions executable by the machine to perform a method of the invention as defined or described herein.

The invention further provides a database of consolidated data records obtained by the method of the invention as defined or described and defined herein.

Those skilled in the art will readily appreciate that invention is not limited in its application to genealogical related data records and family trees. The invention is, likewise, capable of other embodiments and of being practiced out for various applications of related data records.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. IA illustrates a block diagram of a data records management system according to an embodiment of the invention;

Fig. IB illustrates an example of the database architecture in the system of Fig. IA;

Fig. 2 illustrates an exemplified personal record and structure thereof in accordance with certain embodiments of the present invention;

Fig. 3 illustrates an exemplified schematic family tree generated in accordance with certain embodiments of the present invention.

Fig. 4 illustrates exemplified common personal records in accordance with certain embodiments of the present invention;

Fig. 5A illustrates a flow diagram of an example of a method of the present invention for managing personal records;

Fig. 5B illustrates another example of a method of the present invention for management of family trees aimed at merging related two or more family trees;

Fig. 5C illustrates yet another example of method for managing personal records according to the present invention;

Figs. 6 and **7** illustrate two more examples of a method of matching two different family trees;

Fig. 8A illustrates an exemplary family tree merged from two independently constructed family trees, one constructed by a user UA and the other by a user UB;

Fig. SB illustrates an exemplary embodiment of a comparative data set (CDS) arrangement for each of users U_A and UB arranged in a linear array of names;

Fig. 8C illustrates the manner of matching of users UA and UB based on the CDS illustrated in Fig. 8B;

Fig. 9 illustrates an example of a method of the present invention of managing person identifiers;

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the present invention may be practiced without these specific details. hi other instances, well-known methods, procedures, components and circuits have not been described in detail so as not to obscure the present invention.

Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as "processing", "computing", "calculating", "determining", "deriving", "generating" or the like, refer to the action and/or processes of a computer or computing system, or processor or similar electronic computing device, that manipulate and/or transform data represented as physical, such as electronic, quantities within the computing system's registers and/or memories into other data, similarly represented as physical quantities within the computing system's memories, registers or other such information storage, transmission or display devices.

Embodiments of the present invention may use terms such as, processor, computer, apparatus, system, sub-system, module, unit, device (in single or plural form) for performing the operations herein. This may be specially constructed for the desired purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, Disk-on-Key, smart cards (e.g. SIM, chip cards, etc.), magnetic-optical disks, read-only memories (ROMs), random access memories $(RAMs)_5$ electrically programmable read-only memories (EPROMs), electrically erasable and programmable read only memories (EEPROMs), magnetic or optical cards, or any other type of media suitable for storing electronic instructions capable of being conveyed via a computer system bus.

The processes/devices presented herein are not inherently related to any particular electronic component or other apparatus, unless specifically stated otherwise. Various general purpose components may be used in accordance with the teachings herein, or it may prove convenient to construct a more specialized apparatus to perform the desired method. The desired structure for a variety of these systems will appear from

the description below. In addition, embodiments of the present invention are not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the inventions as described herein.

The references cited in the background teach many principles of computerized management of related data records that are applicable to the present invention. Therefore the full contents of these publications are incorporated by reference herein where appropriate for teachings of additional or alternative details, features and/or technical background.

Reference is made to Fig. IA schematically illustrating a block diagram of an exemplary data records management system 100 in accordance with certain embodiments of the present invention. System 100 is configured and operable for management of multiple data records aimed at merging at least one first data record to at least one second data record into one consolidated data record.

It should be understood that the data record may include a group of information pieces treated as a single logical entity. The record may comprise one or more sub-records, each sub-record comprising one or more fields or other logical sub-entities. In some cases, the data record may be a written or paper record, convertible to a form storable in a computer by performing optical character recognition, as is known in the art. A data record may be constructed from data pieces, which are stored in different databases enabling reconstruction of said data record.

More specifically, the present invention is used for management of family trees of individuals and is therefore described below with respect to this specific but not-limiting example. Thus, the first and seqond data records may constitute first and second family trees. A family tree may include any model for organizing one or more data repositories in a hierarchical arrangement comprising at least parent and children nodes. It should be understood that a family tree may be of different complexity, e.g. be as simple as one parent and one child, as complex as the theoretical "single family tree" that links all data in the repositories, etc.; two or more trees may overlap, or one tree may completely include one or more other trees.

System 100 is a computer system including *inter alia* a processor utility 102 and a memory utility 104. System 100 may include a user interface as its constructional part and/or may be configured to be accessible by one or more user interfaces, generally at

106, at remote communication device. In the present example, system 100 is configured to be connectible to a communication network 106 (e.g. the Internet) and accordingly includes an appropriate communication utility 108, and is accessible from one or more user interfaces associated with any communication devices having input and display capabilities (e.g. personal computer, workstation, PDA, telephone, WebTV device, etc.) which are operatively linked to the system 100 through the communication network 106 (via server-client communication session). System 100 thus functions as a server utility installed in a single computer or having multiple modules distributed between multiple computers. The term "computer system" or "server utility" are used herein interchangeably. In certain embodiments of the present invention the user interface may comprise a web-browser.

It should, however, be understood that in certain embodiments of the invention the user interface may be directly associated with the computer system 100. It should also be understood that system 100 functions as a server system as it is installed with the processor utility 102 preprogrammed to provide the data records management function as described herein, and may not necessarily be the network server (e.g. Internet website). It should further be understood that such server function may not necessarily be a dedicated server computer and may comprise an appropriate functionality on an otherwise non-server computer. For example, a computer system serving as the server utility for the purpose of the present invention may at the same time also be a client computer having access to a certain database records via the communication network.

As mentioned above, the server utility 100 may be a single computer or its functionality may be distributed among several different computers. Additionally, the server utility 100 may also be associated with other server utilities running other applications related or not related to building, managing and merging family trees. In certain embodiments of the present invention the server utility 100 may be a server-based host. The server utility 100 may be connected with one or more external databases 112, either directly or through the network.

In the example of Fig. IA, processor utility 102 may be configured as an application program interface (API) and includes a first data processor 102A (which may be one or more software or hardware modules) operable for constructing family trees on the basis of data stored in the memory 104 and/or external database(s) 112, and

a second data processor 102B (which may be one or more software or hardware modules) operable for merging at least two family trees into one consolidated family tree, as will be described further below. It should be noted that in some embodiments of the invention the first data processor 102A may not be in operation during the merging procedure. For example the family trees may be previously created (e.g. by the first processor) and stored in the memory utility 104. In some other embodiments, processors 102A and 102B are parts of different server utilities, and the management system 100 includes only processor utility 102B and has access, through the network, to the database which is created and updated by processor 102A being a part of another server utility.

Fig. IB exemplifies the construction of memory utility 104. As shown in this example, the processor utility 102 (including processor 102B and possibly also processor 102A being utilities of the same or different servers) is operatively coupled to one or more data repositories of the memory 104, for example, an object records database 116, an object identifiers database 117, a family trees database 118, a media items database 119, etc. The processor 102 provides necessary processing and management of data received by the computer system 100 and/or stored in the databases of the memory utility 104 and/or accessed from the external database(s) 112. The processor 102 executes calculations and data management necessary for related data records management process in accordance with the present invention. In certain embodiments, the processing functionality may be distributed between various processing components connected directly or indirectly; or/and a part of said calculations and/or data management may be executed by one or more external systems.

Considering the specific not-limiting example of the invention, where the invention is used for management of data records related to genealogy, the "object" is constituted by a person, a "data record" may for example be constituted by a "family tree" of the respective person, and the "object identifier" may be constituted by a "person identifier". It should be noted, however, that the certain aspects of the present invention are applicable in a similar manner to any other computer-based managing of related data records. The latter may include a group of data records related by common values comprised in and/or associated with one or more sub-records, said common values matching certain criterion.

In accordance with certain embodiments of the present invention a person is characterized by personal record comprising information related to the person. This information is stored in the object records database 116. The information related to the person may comprise name, date of birth, death, marriage, current and former addresses and the dates he or she lived at each address, health-related information, fingerprints and other biometric identifiers; details about relatives, friends and/or colleagues and the nature of the relationship, education related information, curriculum vita, personal preferences, photos, video clips, etc. Said information may be sub-grouped in accordance with different categories (e.g. per information aspects, sources and/or time of receiving information, data formats, per related persons, combination thereof, etc.); accordingly the personal record may comprise one or more sub-records handling the information sub-groups or parts thereof. Information in different sub-records may overlap. Information comprised in a sub-record is referred to hereinafter as a sub-record value.

In addition to the value, the sub-record and/or one or more parts thereof may be characterized by one or more attributes serving to classify the sub-record and/or parts thereof.

According to a preferred embodiment of the invention, a person is also characterized by unique identifier (person identifier) comprising a certain set of data and enabling distinguishing the person from any others with a probability matching certain criterion. This information may be stored in the object identifiers database 117.

According to some embodiments of the invention, the processor utility 102 is preprogrammed for initiating and carrying out the family trees merging procedure. Such initiation of the merging procedure may for example be performed by the processor periodically, or upon identifying certain event (e.g. update in any family tree in response to input of one or more users). Alternatively or additionally, the processor utility 102 may be preprogrammed to carry out the merging procedure, initiated by a user's request.

The merging procedure includes searching in the family trees for the at least two related family trees, namely family trees having at least one matching sequence (according to predetermined criteria); and upon identifying at least one first family tree having at least one matching sequence with at least one second family tree, merging the first and second family trees into one consolidated family tree. The predetermined

criteria may include a minimal number of common nodes and respective connecting line(s) in the two family trees and possibly also weighting factors (as will be described below) of the nodes. The minimal number of common nodes might vary being for example dependent on the nodes' weighting factors.

Reference is made to Fig. 2 illustrating by way of non-limiting example a personal data record 11 of person A. This data record 11 presents the family tree data of person A_5 namely a family tree previously created for person A (based on his/her input) and stored in the family trees database (118 in Fig. IB) or a family tree creatable for person A based on data stored in object records database (116 in Fig. IB) and object identifiers database (117 in Fig. IB). The personal data record 11 comprises a main record part 17 including the personal data of person A, e.g. his/her name, date of birth, last updated address, profession, etc., and comprises at least one sub-record, assigned to the relative(s) of the person A_5 three such sub-records 12-A, 12-B and 12C being shown in the present example. These sub-records 12-A, 12-B and 12C are characterized by sub-record values 13-A_5 13-B, 13-C, respectively, and by respective attributes 14-A_5 14-B_5 14-C indicating relationship between the person A and the corresponding relative. This is illustrated in the figure in a self-explanatory manner. The person identifier 15 of person A (being a data piece of the data stored in object identifiers database 117 shown in Fig. IB) is associated with the personal data record 11 and is generated based on at least part of information comprised in the personal data record 11. Information in a sub-record of the person A data record assigned to the person A relative may constitute a part or entire personal data record of said relative.

Referring back to Figs. IA and IB, the information in the personal data records may be received (e.g. via communication with a user, in a pull or push mode) from the corresponding person and/or other users and/or one or more data repositories in the computer system 100 and/or one or more external data sources 112. The personal data records are stored in the object records database 116. Optionally, one or more subgroups of information related to the person and stored in certain media formats (e.g. photo, audio and/or video files, etc.) may be stored in the media items database 119 and be handled as sub-records constituting a part of the corresponding personal data record. As will be further detailed with reference to Figs. 3-9, the processor utility 102 is configured to update the personal data records in accordance with teachings of the present invention.

As will be further detailed with reference to **Fig.** 9, the processor utility **102** is configured to generate, update and/or compare the person identifiers in accordance with data received from a corresponding person and/or other users and/or data comprised in one or more data repositories in the computer system **100** and/or one or more external data sources **112.** The person identifiers are stored in the object identifiers database **116.** As will be further described with reference to **Fig.** 9, in certain embodiments of the invention the person identifier comprises at least subset of information (and/or derivatives thereof) comprised in the corresponding personal data record. Nevertheless, a part of information (and/or derivatives thereof) comprised in the person identifier (e.g. information related to trustworthiness of the person identifier) may be absent in the corresponding personal data record. In certain embodiments of the invention the person identifier and/or derivatives thereof constitute a part of the corresponding personal data record.

The computer system **100** is also capable of generating and/or presenting to a user (e.g. via user's interface) a family tree related to one or more persons as will be further described with reference to **Figs. 3-9.** One or more family trees may be generated for a period of the user's login to the system and/or may be stored and maintained in the computer system **100** (e.g. in the family trees database **118),** in a device associated with the user's interface, external data base, etc.

The data repositories may be updated in different modes, for example, based on data received from different sources (e.g. users, one or more other data repositories, external sources, etc.) in push mode and/or pull mode (e.g. per user's request, per request generated by the processor utility **102,** per predefined event), etc. The input of data in the databases may be manual (e.g. by the person or another users), combined (e.g. including user's authorization for input of pushed data) or fully automated (e.g. from external sources).

One or more data repositories may comprise criteria, conditions, algorithms and/or programs related to the management of related data records in accordance with certain embodiments of the present invention.

Those skilled in the art will readily appreciate that the invention is not bound by the configuration of Figs. 1A-1B; equivalent functionality may be consolidated or divided in another manner. In different embodiments of the invention the blocks and/or parts thereof may be placed in multiple geographical locations; operative connections

between the blocks and within the- blocks may be implemented directly or indirectly, including remote connection. The connection may be provided via Wire-line, Wireless, cable, Internet, Intranet, power, satellite or other networks and/or using any communication standard, system and/or protocol and variants or evolution thereof,

Those skilled in the ait will also readily appreciate that the databases comprising information related to the persons, derivatives thereof and/or other information related to the system operation may be consolidated or divided in other manner, some of these databases may be external to the computer system 100 and/or may be managed by 3rd parties.

Referring to Fig. 3, there are exemplified simplified family trees generated in accordance with certain embodiments of the present invention. Three family trees 211, 212 and 213 are shown, hi which persons (or family tree members) are represented by nodes in a manner known in the art. Relationships between the nodes correspond to real life relationship between persons represented by the nodes.

For example, the family tree 211 represents the personal data record of person A, an individual born in the latest (first) generation and represented in the tree by the bottom-most node 0. The person A has a father and a mother represented by nodes 00 and 01, respectively. The father 00 and the mother 01 are in the second generation working backwards from the first generation. The tree 211 also includes such nodes as the father's father 000, the father's mother 001, the mother's father 010, and the mother's mother 011 who represent the third generation in the tree. The illustrated tree may be extended further back for any number of generations. Also, the tree 211 includes father's sister 01i and her daughter O_1 being a cousin B of the person A. The family tree 212 represents the personal data record of person B, an individual born in the latest (first) generation and represented in the tree by the bottom-most node O_1. The person B has a father and a mother represented by nodes $0O_1$ and Olj, respectively, where the person B mother $0I_1$ is the sister of the person A father.

Thus, the family trees 211 and 212 represent relationships between one or more persons having related personal records, said relationships being characterized by attributes of sub-records in the corresponding personal records. Each node of the family tree bears information includmg at least subset of information (and/or derivatives *thereof)* comprised in the corresponding sub-record assigned to the corresponding represented person.

Different family trees may comprise nodes representing the same person. Nodes in different trees corresponding to the same persons (e.g. persons with matching person identifiers) are considered as common nodes, and the trees comprising such common nodes are considered as related.

For example, the nodes $0I_1$ and O_1 constitute family tree **212** of person B while comprising also other node(s) relating to person A, i.e. node $0O_1$ corresponding to father of the person B cousin. The tree **212** thus has common nodes 01_1 and 0_1 with the tree 211, and accordingly, the trees **211** and **212** may be considered as related trees, or trees having at least one matching sequence according to predetermined criteria. In this specific example, the matching condition (criteria) is the existence of a sequence formed of at least two common nodes and a connecting line between them. The tree **213** represents a result of fully merging the trees **211** and **212.** Thus, the related personal data records may be updated by consolidating one or more sub-records and information thereof; accordingly, the related family trees may be fully or partly merged to generate one or more new trees representing the updated records.

Thus, in accordance with certain embodiments of the present invention described with reference to Figs. 2 and 3, a person is characterized by a personal record and a person identifier. Information in the personal record may be grouped, for example, in subgroups related to the relatives of the person. Accordingly, the personal record may comprise sub-records assigned to the relatives represented by the appropriate nodes of the family tree.

As illustrated by way of non-limiting example in **Fig.** 4, the personal record **11** of the person A comprises sub-records **12-A**$_5$ 12-B, 12-C and other (not shown) assigned to other persons represented in the family tree^ll. Said persons represented by the nodes in the tree are characterized by their own personal records comprising sub-records assigned to the family members as, for example, personal record **21** of cousin B comprising sub-records 22-A, **22-B** and other (not shown). The personal record of cousin B is characterized by person identifier **25,** as well as each sub-record in the personal records **11** and **21** corresponding to assigned family member is characterized by corresponding person identifiers 15-A, 15-B, **15-C,** 25-A, **25-B** accordingly.

In accordance with certain embodiments of the present invention, two personal data records or family trees are considered as related records or mergeable family trees, if they comprise at least two common sub-records, namely sub-records assigned to the

same persons, which are identified by match in the person identifiers. Three or more personal data records are considered as related records if each pair of records among said three or more records comprises common sub-records. Common sub-records may be characterized by different attributes classifying relationship between persons.

For example as illustrated in Fig. 4, the personal record 11 of the person A and the personal record 21 of the cousin B are related as having common sub-records 15-C and 25-A accordingly, assigned to the same person. However said common sub-records have different attributes indicating mother-child relationship in one record and aunt-nephew relationship in the other record.

The attributes may characterize relationships between first degree family members (parents, brothers and sisters, spouse, children) as well as further (second, third, etc.) degree family members (grandparents, cousins, in-laws, etc.). The family members included in the relationship data may be living or dead, the relationship may be past or present, etc. In certain embodiments of the present invention the attributes may characterize other types of relationships including, for example, friends, acquaintances, neighbors, business colleagues or associates, members of societies or organizations to which the individual belongs, and others.

The sub-records' values 13A, 13B and 13C in the data record of person A, as well as sub-records' values 19A and 19B hi the data record of person B, actually present weighting factors of the respective nodes. It should be noted that common sub-records in the family trees' data records do not necessarily have the same value. For example, sub-record 15-C assigned to aunt 01i in the personal record 11 of the person A may be less detailed than the corresponding common sub-record 25-A hi the personal record 21 of the cousin B assigned to her. mother 01 (aunt 01i of the person A). Sometimes, common sub-records, although being assigned to the same persons (i.e., with matching person identifiers), may comprise non-identical and at times even contradictory information. For example: data on a related individual may include attributes incorrectly entered, e.g. incorrect birth date, address, etc; name of an individual included in a sub-record may be differently inputted by different individuals, e.g "Michael" may be inputted as such by one and as "Mike", "Mich", or "Micha" by another or the name "Jonathan" may also be "John", "Johnny", etc.; there may be mismatches as results of uses of different languages for data entry by different individuals; and so forth.

Referring to **Fig.** 5A, there is illustrated a flow diagram of an example of a method of the present invention for managing multiple data records (family trees) for merging two or more of them. As described above, corresponding person and/or other users may enter information for creating and updating one or more personal data records. The personal record may be also updated by the management system **(100** in Figs. IA and IB). The process of merging the family trees may be initiated by a user, or by the management system. In some embodiments, the system starts this process periodically, and upon detecting mergeable tree(s) or upon performing a merge, indicates the same to the user, allowing him/her to display the results.

Thus, in the present not limiting example, the system starts updating the family tree of person A (step **311),** based on information stored within the memory utility of the system (e.g. other personal records) or in one or more external databases. Such update may be initiated per request of the user, per predefined time schedule, per predefined event, combination thereof, etc. For example, the management system may be configured to initiate an updating of the personal record A. This may be done periodically, e.g. every month, and/or when a certain condition is satisfied, e.g. when total number of sub-records assigned to relatives achieves some predefined threshold, and/or after receiving new and/or certain type of information from the user, etc.

After starting the update, the computer (its processor utility) searches for personal records likely to be related to the personal record A to be updated (step **312).** In certain embodiments of the invention the sub-records assigned to certain persons comprise corresponding person identifiers, derivatives or links thereof; accordingly, the likely related personal records may be found by looking for pairs of likely matching person identifiers comprised in (or corresponding to) sub-records of different personal records.

After pairs of likely matching person identifiers have been found, the computer system operates to compare the person identifiers or derivatives thereof (step 313), so as to find discrepancy (any compound discrepancy, including, for example, several discrepancies and/or their combination) among likely related person identifiers, and to determine whether the discrepancy matches certain criterion (step **314).**

If the discrepancy matches certain criterion (e.g. likelihood that the person identifiers characterize the same person is higher than certain probability, for example predefined in the management system (e.g. 80%), and/or set by the person or other user,

and/or average probability for related records, etc.), the computer system operates to obtain related personal records, i.e. personal records having common sub-records, and to select among the obtained personal records those records which are to be used for further update and/or sub-records to be consolidated with the personal record A (step 315). If the discrepancy does not match the criterion, the computer system may deny the record as non-related, or may request the user to authorize that two sub-records are assigned to the same person (step 316-1). In certain embodiments of the invention the computer may request the user or one or more external sources for additional information (optional step 316-2), update person identifier(s) accordingly and repeat the comparing operation (step 313).

Comparing the person identifiers may be provided in several ways, some of which are known in the art. Certain embodiments of comparing person identifiers in accordance with present invention are further detailed with reference to Fig. 9. The related personal records to be used for further update of the personal record A may be selected in accordance with configurable or predefined criterion, e.g. all related records, related records having common sub-records characterized by certain attributes (e.g. certain generation, certain genealogical line, etc.), related records with predefined number of common sub-records, etc. The sub-records among the selected related personal records may also be selected to be used for the further consolidation in accordance with configurable or predefined criteria, e.g. only sub-records being common or being non-common with sub-records in the personal record to be updated, sub-records characterized by certain attribute, sub-records comprising certain fields (e.g. address at certain period of time, profession, education, etc.) and/or other criteria.

One or more sub-records among the sub-records selected for consolidation may be common (while not necessary common witii sub-records in the personal record A), i.e. to be assigned to the same person. Said sub-records selected for consolidation may have different values (i.e. contain different information or have different weighting factors); information comprised in one record may complement or contradict information in the other(s) as described above. The computer system operates to compare values of said common sub-records (step 317).

If there is no inconsistency between sub-records or there is no contradiction between inconsistent information, the information comprised in the common sub-records is combined. If information in one common sub-record contradicts information

in the other(s), the computer system may select information from one of the sub-records in accordance with predefined selection criterion, deny using the contradicting sub-records for update of record A, ask the user to select the proper sub-record or *to re-configure* selection criterion, etc. (step **319).** The selection criterion may be related to the time of sub-record updating, source of information comprised in the sub-record, etc. For example, the trustworthiness of sub-record may be ranked in accordance with its attribute characterizing relationship between the person assigned to the sub-record and the person characterized by the record (e.g. the sub-record 22-A in Fig. 4 may be ranked as more trusted than the sub-record **12-C).**

The computer system then operates for consolidating the sub-records selected for further update with the personal record A (step 318), thus generating the updated personal record A (step 320). Said consolidation may include combining information comprised in the common sub-records.

As sub-records and/or parts thereof may have different attributes reflecting different relationships of the same persons in different personal records, the consolidation may also include reassignment of attributes characterizing sub-records and/or parts thereof. Such reassignment may be provided, by way of non-limiting example, in accordance with lookup table associating initial and reassigned attributes in accordance with relationship between the person characterized by the personal record to be updated (person A), the person characterized by the related record comprising appropriate sub-record and/or the person to whom said sub-record is assigned.

The family tree representing the updated personal record may be generated (step **320)** automatically or per user's request.

It is to be understood that the described operations may be provided on any or all of the records and the information thereof, and may use methods known to those skilled in the art or methods that are apparent in light of this disclosure.

Those skilled in the art will readily appreciate that the operations described with reference to **Fig.** 5A may be implemented in a similar manner on a level of personal records presentation (e.g. family trees). Accordingly, the nodes comprised in two or more family trees may be directly or indirectly associated with corresponding person identifiers in a manner that for each of said nodes corresponding person identifier characterizes the person represented by the node. At least one of the related family trees, i.e. family trees comprising nodes associated with person identifiers characterizing the

same person, may be updated by consolidating (merging) the nodes comprised in said family tree with nodes selected among nodes comprised in the other related family trees.

Fig. 5B illustrates another flow diagram pertaining to an example of a method of the present invention for managing users family trees related data. In this example, the management system is preprogrammed for operating with a certain mode (per user's selection) where the merging procedure is initiated by the system upon detecting a data update from said user, in particular update relating to the entry of new nodes to the family tree (and hence filling of additional sub-records).

Thus, user A enters certain data relating to his personal data record (step **120).** The processor utility **(102** in Figs. IA **and** IB) identifies this data entry and operates to check whether the entered data requires update in the user A family tree (step **121).**

If the data entry requires update in the family tree, the processor utility operates to create the user A updated family tree (step **122).** The system may for example operate to display the updated family tree to the user A or confirm to the user that the family tree has been updated (optional step 123), and if the added data gives rise to the possibility of merging the family tree of user A with another family tree, a merging process may be initiated (step **126).** The merging may occur automatically or may be user-initiated, e.g. in response to a prompt by the system which may, for example request the user A permission to attend to a merging procedure (optional step **124).** It is also an option that the merger procedure occurs virtually, regardless of user A permission, and will manifest itself in user A's family tree only if so initiated by user A.

Thus, if the family tree is updated and/or user A instructs the system to attend to the merging procedure, the processor utility starts the merging procedure (step **126).** To this end, the processor utility operates to search in the family trees related database (step **127)** to identify another one or more related family trees in accordance with a predefined condition (e.g. trees having at least one matching sequence including a predefined minimal number of common nodes and connecting line(s)) - step **128.**

If the predefined condition allows finding at least two related trees satisfying this condition, consolidated family tree is created (step **129)** and data indicative thereof is generated for the user (step 130), e.g. the consolidated family tree is displayed to the user.

If the predefined condition (e.g. the existence of at least a defined number of common nodes and/or a certain weighting factors in the two family trees) does not allow finding related family trees, the system may generates a corresponding message to the user (step 131), for example prompting the user to add more data required for the merge.

Reference is made now to Fig. 5C displaying a flow chart of yet another example of merging and consolidating of family trees inputted by different users. In a first step 332, each of a plurality of users (U_1 … UN) inputs data into a database, including the main personal records and sub-records as defined above (the sub-records including data on related individuals). The system then generates a family tree (step 334) for each of users U_1 ... UN- A S will be appreciate, this generation of a family tree is an ongoing process and the family tree gradually grows as more data on related individuals is added. While the family tree is being built, comparative data sets CDS_1 … CDSN (generally CDS) is generated or defined for users U_1 ... UN, respectively (step 336). It should be appreciated that while step 336 is shown herein as being in sequence after step 334 these two steps may also proceed in parallel. Additionally, similarly to the generation of respective family trees for each of users U_1 ... UN, also CDS_1 ... CDSN may be gradually generated as more data is entered by the users. It should also be appreciated that the data entry of different individuals is not all at once and may occur over an extended time period. It is to be noted further that the procedure of steps 334 and 336 (whether conducted in parallel or in sequence) is ongoing as long as data is inputted by users in step 332. Accordingly, as will readily be understood, the process of comparing, matching, merging and updating as described further below may be resumed when more data is inputted or periodically. Typically, although not exclusively, the process as described below may be carried out on each newly added data relating to a user or whenever the user updates the data.

For each user Ux the corresponding CDSx is compared with the CDSs of other users (CDSz) to find a match (step 338). For a match to occur there needs to be a predefined minimal number of matching identifiers between the two CDSs that jointly define a match with a high probability. Some matching strategies will be exemplified below. Also, different identifiers may be given different weights and may accordingly be assigned with a weighting factor. Such weighting factors may also be factored-in to determine a match (step 340). If a match is determined, the process proceeds to define a

merge between the family trees of users Ux and Uz (step 344); if not, the process ends (step 342), possibly temporarily until more data will be added by user Ux. User Ux may receive a message by the system, typically automatically generated, suggesting him to add more data, particularly data on related individuals.

Thus, once a match is identified a merge is defined between family tree of Ux and another Uz (step 344). The merge may occur automatically within the system. Users Ux and Uz may also each receive a message (step 346) advising them that a match has been detected and requesting permission to do the merge. The system then verifies that both users gave their permission (step 348). If in the affirmative, the process proceeds to do the merge (step 352) and the merged tree may then be graphically displayed to both users, may be presented in a tabular or data form, may be forwarded to one or both users as an electronic file (e.g. by email), each user may receive a printed copy of the merged tree, etc. If no permission is given, the process ends at 350. In case of no permission the system may be programmed to periodically request permission for the merge. In accordance with some embodiments of the invention permission of both Ux and Uz is required for a merge to occur; in accordance with other embodiments permission of one of the users may be sufficient, e.g. the non-permitting user may still have available to him only his entered data.

Upon merger, the data in the two family trees may optionally be consolidated by mutual update of the data fields in both family trees (step 354), the data of family tree of the two users being independently stored as two separate, albeit identical, data records, e.g. in different data repositories, or the data may be consolidated into one consolidated data record, accessible by both users.

It should be understood that the methods of the current invention are not limited to or by the steps in Fig. 5A-5C. In some cases, a method combining the characterizing features of these methods is used, in other cases slight variations on one or more of these flowcharts are applied. For example, in some cases steps 318-320 of the method of Fig. 5A and step 352 of the method of Fig. 5C are identical.

The data stored in the computer system may be used to form family trees, tables and organizational charts, as is explained in more detail hereinbelow.

Reference is made to Fig. 6 illustrating an example of a method of the present invention for matching a number of comparative data sets (CDSs) in two different

personal data records. In this example, the personal identifiers are constituted by names that are organized in a sequential manner.

It can be seen in **Fig.** 6, that two strings 350, **360** of personal identifiers have six similar records (ABRAHAM **351:ABRAM** 371; ISAAK 352:ISAAC 363; JACOB 353, YAAKOV 364; JOSEPH 354, JOSEPH 373; RACHEL 357, RACHEL 372, BENJAMIN, 358, BENJAMIN 374). The management system has an appropriate processing utility applying a phonetic algorithm to the similar names (the similarity being identified according to a certain criterion), ABRAHAM 351:ABRAM 371; ISAAK 352:ISAAC 363; JACOB 353, YAAKOV 364, to determine whether there are, in fact, three matching identities. The outcome, in this case, is positive and thus there are six matched data bits or personal identifiers.

Names, typically first and/or second names or a combination of a first and/or second names and family name, are one preferred personal attribute included in the CDS that is used for the purpose of searching for a match. However, other attributes such a profession, age, hobby, body-related attributes (eye or hair color, height, complexion, etc.), and so forth may also be used.

In another embodiment, two family trees may be compared by studying their topology. **Fig.** 7 illustrates an example of match in two different family trees **380, 390.** Each family tree is represented by multiple nodes and connecting lines between them, each node corresponding to a family tree member, and the connecting line between two nodes corresponding to a relationship between the respective family members. There may be, in some cases, no data relating to the individuals of the family tree beyond their names, thus each node being represented by an individual's name. In other instances attributes other than the name may be represented by the node. The management system compares family tree **380** with family tree **390.** As shown, six matching (common) nodes D, E, F, G, H, I and connections between them are found in the two family trees. This condition may be sufficient (according to predefined criteria) to merge the two family trees 380, **390** together. If affirmative, the management system operates to merge the family trees together (step **340** in the example of Fig. 5C, or steps 318, **320** in the example of Fig. 5A).

It should be understood that a condition for merging between the family trees or generally data records may be predefined by a minimal number of common nodes and their associated connection lines. The minimal number of common nodes and

connections may be 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15. The minimal number may vary in accordance with a system-defined permitted degree of uncertainty; culture and society-related demographic factors, such as the overall name variety or the practice of using (or not using) the same names repetitively within a family; and others. The merging algorithm may also take a weighting factor of different attributes into consideration.

Reference is now being made to **Fig.** 8A, illustrating an exemplary graphical representation of a merged family tree. The merged family tree is a merging product of two independently constructed family trees by two users, designated in Fig. 8A (and in Figs. 8B, 8C and 8E) as UA and U_B, both being circled in the family tree for emphasis. The bounds of the two separately constructed family trees are presented by two broken lines: the family tree constructed by U_A are left of the broken line marked "UA"; the family tree constructed by UB is right of the broken line marked "U_B".

In Fig. 8A, each individual is a node in the family tree and is represented by a letter and index numeral. The letters and indices numerals are arbitrary and have no special significance (other than successive generations are indicated with progressing letters - from A to D; the index numeral are simply serial numbers from left to right for members of each generation). Two individuals related by marriage are connected by horizontal lines. Thus, for example, Ai is married to A_2 and C_2 is married to C_3. A vertical line signifies a parent-child relationship. Thus, for example, A_3 and A_4 are parents of B_3 and B_4; C_5, UB and C_7 are children of B_4 and Bs (and grandchildren of A_3 and A_4). B_6 is a single parent to C_8.

Each of U_A and U_B construct their family tree: their personal data constituting the main record, and data including names and possibly other data on related individuals constitute the sub-records. In fact, the family trees are a graphical representation of each of the users' personal data records.

The personal data records of each of users UA and UB are used to construct a CDS which according to one embodiment is a linear string of personal identifiers of each of the individuals represented in the family tree. The data relating to each of the users and constituting the main user-associated data record may be part or may not be part of the CDS. An example of such a linear CDS string formed for each of users U_A (upper string) and UB (lower string) is shown in **Fig.** 8B. By one specific embodiment, the identifiers included in the data string are names. However, in addition or in the

alternative other personal attributes, such as those noted above, may also be included. The order of individuals in the string is determined, in some embodiments, in accordance with a pre-defined hierarchy. In the exemplified string the sequence is in the following order of user relatives: father, mother, spouse, children, siblings, grandparents from father side (GPF), grandparents from mother side (GPM), other children of GPF, spouses of such children and their children, other children of GPM, spouses of such children and their children, and so forth.

Fig. 8C shows two different ways of matching a sequence of nodes from the CDS strings of each of users UA and U_B shown in Fig. 8B. hi the upper part of the figure, a six-member continuous sequence out of the UA string is paired against a matching sequence out of the UB string. However in the case of user U_B, the link between B_3 and C_1 is indirect but goes through another member B_2 and similarly the link between C_2 and C_4 is also indirect and goes through UA- However, in a manner analogous to that used to search for common sequence patterns of nucleic acid sequences in the field of computational biology, such additional members of the sequence are discarded and a match may be determined as shown graphically in the figure. In the lower part of the figure an alternative manner of matching is shown which is self explanatory. Typically, albeit non-exclusively, a common sequence of six members in two CDS strings may be considered a match with a high probability. However, for different societies the threshold of a length of a sequence to be considered a match may vary, e.g. contingent on the name use pattern in a given society (in a society where only a limited number of names are used, and where the name is used in the string, the threshold may be placed at a sequence length of higher than 6 that should be essentially the same in both strings.

In the specific example shown in Fig. 8C, there is an additional sequence of 3 individuals in the string that shows identity between the UA and UB strings - ...C_6-D_2-D_3- ... - which may serve to further verify the match.

In accordance with another embodiment a plurality of vectors are constructed each one consisting of two persons and their attributes. Examples of vectors are such constructed for the pairs of individuals A3-A_4, A_3-B_4, A_3-B_3, B_4-U_{B5} D_2-D_3, ... etc. Merging the family trees may also be based on matching a predetermined number of such vectors in the two family trees.

Based on a match as described above, the two trees are merged to yield the illustrated merged tree.

Another manner of matching one family tree-related data record to another is based on defining for each such data record a plurality of short relationship-defining sequences, each one consisting of at least one pair of nodes that represent a first-degree relationship including parent-child, siblings, couple (including married and non-married). In the family tree shown in Fig. 8A example of such pairs are B_4-B_5, B_4-C_5, UB-C_6, etc. In addition to pairs, such short sequences may also include a 3-member continuous sequence, a 4-member continuous sequence, etc. A 3-member sequence may, for example, include: grandparent-parent-child (e.g. A_4-B_4-UB); child-parent-parent sibling (e.g. U_A-B_3-B_4); husband-wife-wife sibling (e.g. B_2-B_3-B_4); parent-child-child-in-law (e.g. B_7-C_{10}-C_{11}); etc. A 4-member sequence may include: child-father-grandfather-great grand parent (e.g. D_3-U_B-B_5-A_5); child-parent-parent sibling-spouse of such sibling (e.g. UA-B_3-B_4-B_5); etc. In order to search for a matching family tree, other, related trees with identical sequences are searched. In the specific example of Fig. 8A, the family tree of UA and that of U_B will both include pairs such as A_4-A_3, A_4-B_4, B_4-C_5, etc. Upon finding of at least a predetermined minimal number of such short sequences common to two family trees a match may be defined and the two trees can then merge. The predetermined minimal number of the short sequences is chosen so as to ensure a match with high probability.

Referring to **Fig.** 9, there is exemplified a flow diagram showing principal operations of managing person identifiers according to another embodiment of the invention.

In accordance with certain embodiments of the present invention, the management computer system, based on the person-related information, generates the person identifier in association with creating personal record (family tree) and/or sub-record related to the person (e.g. data related to the family tree node corresponding to the family tree member and his relationship to one or more other family tree members). The system operates to associate the person identifier with corresponding personal record and/or sub-records. The association may be provided by including the person identifier or derivatives thereof in the record and/or sub-records, and/or by providing the records and/or sub-records with links and/or other indications to corresponding person identifiers, etc.

In certain embodiments of the invention the person identifier is generated in a form of dataset comprising predefined set of building blocks (e.g. fields in the person identifier record or other logical entities) organized in predefined sequence order, wherein at least part of said building blocks comprises information derived from the respective personal record. In certain embodiments of the invention the building block(s) may hold the information in a coded form.

The building blocks may be organized in a string structure. The person identifier, by way of non-limiting example, may include the building blocks comprising relatives-related information: first name of the person (1st building block), family name of the person (2nd building block), name of father (3rd building block), name of mother (4th building block), mother's maiden name (5th building block), names of grandfathers (6th and 7th building blocks) and grandmothers (8th and 9th building blocks), etc. The order of the building blocks in the exemplified personal identifier is provided in accordance with respective relationships. In certain embodiments of the invention, the number of building blocks in different person identifiers may differ. For example, the person identifier may include a range of building blocks related to all sisters and brothers, said building blocks within the range being organized per date of birth. The number of building blocks in the range varies for different persons.

The information derived from the personal records may be held in the building blocks in the original form (as entered or otherwise obtained) and/or as derivatives thereof. For example, as names of persons, geographical names or other names may be differently spelled, the original data may be normalized by using a phonetic algorithm (e.g. double metaphone, SOUNDEX and/or alike) before storing in the building blocks. As a rule, phonetic algorithms are not enough to cope with the differences caused by different languages. For example, descendants of a person with name Jacob living in different countries may enter his name as Yaqub (Arabic), Hakob (Armenian), Jaakko (Finnish), Jacques (French), Jakob and Jacob (German), Iakovos (Greek), Ya'akov (Hebrew), Jacobo, Jaime and Yago (Spanish), *etc.* In certain embodiments of the present invention all known variations of certain personal, geographical or other names may be normalized before storing and then hold in a unified form (e.g. Jacob or some coded name for any of variety of names above) in addition or instead of storing the original form.

Those skilled in the art will readily appreciate that the teachings of the present invention related to information normalization are applicable in a similar manner to any other information stored or to be stored in the disclosed system.

Comparing the person identifiers includes comparing the corresponding building blocks (step 411). For example, in certain embodiments of the invention, the building blocks may be organized in certain predefined sequence order with empty blocks when necessary, and/or the building blocks may have pre-assigned sequential block numbers regardless of the preceding blocks actually comprised in the sequence (for example, as illustrated in Table 1 providing non-limiting example of pre-assigned sequential numbers to be used with the certain building blocks, the building block related to person's date of birth will have sequential number 30 regardless of other blocks, e.g. actual number of sisters and brothers).

Table 1.

Building blocks comprised in a person identifier	Pre-assigned sequential numbers
First name of the person	1
Family name of the person	2
Name of father	3
Name of mother	4
Mother's maiden name	5
Name of grandfather (father's father)	6
Name of grandfather (mother's father)	7
Name of grandmother (father's mother)	8
Name of grandmother (mother's mother)	9
Names of sisters	10-19
Names of brothers	20-29
Date of person's birth	30

In such and similar embodiments the person identifiers may be compared with the help of one or more algorithms comparing building blocks with the same sequential number. The system operates to determine whether the resulting number of substantially identical building blocks fits certain criterion (e.g. predefined number of non-empty substantially identical building blocks) - step 412. If positive, the person identifiers are

considered as characterizing the same person. In certain embodiments of the invention the criterion may be configured, for example, as matching probability, weighed matching probability calculated in accordance with number of identical building blocks and information trustworthiness likelihood, and/or other wise.

hi certain embodiments of the invention when the person identifier comprises building blocks, the process of comparing the person identifies for obtaining related personal record detailed with reference to Fig. 5A may be provided, for example, as following: The system may operate on all person identifiers stored in the database for initial comparing per predefined limited set of building blocks (e.g. only comprising information about person's name and date of birth), thus giving rise to likely matching person identifiers. Then, the rest building blocks may be compared operating on likely matching person identifiers.

In certain embodiments of the invention the system may continue comparing the person identifiers even if the resulting number of substantially identical building blocks does not fit certain criterion. Lack of information may be one of the reasons of inconsistency; accordingly, the system checks if one of comparing building blocks is empty while the other(s) comprises some information (step 413). If "YES", the system may request the user and/or one or more external sources for additional information, or ask the user to confirm that information in non-empty block(s) is right; and update the empty building block accordingly (step 414). If "NO", the system may check possibility of further correction of information comprised in the inconsistent building blocks (e.g. to ask user to correct information, provide user with certain variants of information to be selected, check possibility of normalization or re-normalization of names, etc.) and update the building blocks accordingly (step 415). After the update the system repeats operation of comparing the corresponding building blocks (step 416). The system operates to determine if the number of substantially identical (matching) building blocks fits certain criterion (step 417), and if "YES" the person identifiers are considered as characterizing the same person and the system thus updates the person identifier(s) in accordance with updated building blocks (step 418).

If the inconsistency occurs for building blocks being a part of certain range of building blocks (e.g. range 10-19 for sisters in Table 1), the system may also re-order the sequence of respective building blocks within the range and repeat the comparing process as above.

Optionally, if the number of substantially matching building blocks does not fit certain criterion, the system may modify comparing person identifiers by changing the predefined set of building block and generating new person identifiers in accordance with the new set. Such modification may be effective, for example, if information lacks in many blocks, if there is reasonable assumption of information incorrectness, etc. The modification may be provided by request of an authorized user and/or if the building blocks in the original person identifier fit certain criterion (e.g. more than 50% of blocks are empty). The system repeats the comparing operation of the modified person identifiers as detailed above. Typically, the modified person identifiers are generated as temporary objects for certain comparing operation(s).

In certain embodiments of the present invention one or more person identifiers may be ranked in accordance with their trustworthiness. The ranking may be provided in accordance with different criteria, e.g. total number of sub-records associated with certain person identifier, number of successful comparing operations, number of updates during comparing operations, source and/or time of last update, etc. Information in some personal records may pass special certification with regards to its trustworthiness, accordingly, person identifiers associated with such records and sub-records thereof may be used as a highly-ranked pattern for matching and appropriate ranking of the other person identifiers.

It is to be understood that the invention is not limited in its application to the details set forth in the description contained herein or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. It should be noted that the invention is not bound by the specific algorithm of processing or specific structure. Those versed in the art will readily appreciate that the invention is, likewise, applicable to any other processing or presentation with equivalent and/or modified functionality which may be consolidated or divided in another manner.

It will also be understood that the invention further contemplates a machine-readable memory tangibly embodying a program of instructions executable by the machine for executing the method of the invention.

Those skilled in the ait will readily appreciate that various modifications and changes can be applied to the embodiments of the invention as hereinbefore described without departing from its scope, defined in and by the appended claims.

CLAIMS:

1. A method for computerized consolidation of data records among plurality of data records, each data record comprising a main record on a first object and at least one sub-record assigned to a second object related to the first object, the method comprising:

(a) comparing a first data record with one or more second data records; and

(b) consolidating the first data record and at least one of the second data records responsive to determining a match between comparative data items in the first and second data records, said comparative data items comprising data from one or more sub-records.

2. A method according to Claim 1, wherein said consolidating comprises determining a match between comparative data items from sufficient number of the comparative data items.

3. A method according to Claim 2, wherein said sufficient number is at least two.

4. A method according to Claim 2, wherein said sufficient number is six.

5. A method according to any one of the preceding Claims, wherein said comparative data items further comprise one or more attributes of the main record of the first and second data records.

6. A method according to any one of the preceding claims, comprising:

- determining probability that said first and said second data records are identical on the basis of the number of matching comparative data items in the two records, and

- consolidating said first and second data records where said probability exceeds a predetermined level.

7. A method according to any one of Claims 1-6, wherein said first data record and said second data record are contained within the same database.

8. A method according to any one of Claims 1-6, wherein said first data record and said second data record are contained in different databases.

9. A method according to any one of the preceding claims, comprising for each data record generating a comparative set of comparative data items, said consolidating being responsive to a match in majority of data items in the comparative set between the two data records.

10. A method according to Claim 9, wherein said comparative data items are represented in the comparative set in a linear or a two dimensional matrix of data items.

11. A method according to any one of the preceding claims, wherein the first object is a first person and the second object is a second person related to the first person.

12. A method according to any one of the preceding claims, carried out over a computer network.

13. A method according to Claim 12, wherein the computer network is the Internet.

14. A method for computerized consolidation of personal data records among plurality of personal data records, each of said data record comprising a main record on a first person and at least one sub-record assigned to a second person that is related to the first person, the method comprising:

(a) comparing a first personal data record with one or more second personal data records; and

(b) consolidating the first data record and at least one of the second data records responsive to determining a match between comparative data items in the first and second data records, said data items comprising data from one or more sub-records.

15. A method according to Claim 14, wherein said consolidating comprises determining a match between comparative data items from a sufficient number of the comparative data items.

16. A method according to Claim 15, wherein said sufficient number of the comparative data items is constituted by at least two persons and relation between them.

17. A method according to Claim 15, wherein said sufficient number of the comparative data items is constituted by six persons and relation between them.

18. A method according to any one of Claims 14-16, wherein each of the personal data records is a data record on an individual in a family tree database.

19. A method according to Claim 18, further comprising merging a first family tree including said first data record with one or more second family trees including said second data records to generate a merged family tree.

20. A method according to Claim 19, wherein said merging comprises at least one of importing, exporting, transforming and superimposing by a process selected from:

(a) merging a database record in the first family tree with a graphical display record in the one or more second family trees;

(b) merging personal data records from two or more family trees;

(c) merging a graphical display record in the first family tree with a graphical display record in one or more other family trees;

(d) consolidating person-indicating nodes comprised in the first family tree with person-indicating nodes in the one or more second family trees.

21. A method according to Claim 19 or 20, further comprising displaying the merged family tree.

22. A method according to any one of Claims 14-21, comprising:

- for each personal data record generating a comparative set of comparative data items, and

- performing said consolidating in response to determining a match in majority of comparative data items in the comparative set between the two data records.

23. A method according to any one of Claims 14-22, wherein said comparative data items comprise one or more attributes of the main record.

24. A method according to any one of Claims 14-23, comprising:

- determώiing probability that said first and said second data records are identical on the basis of the number of matching comparative data items in the two records, and

- consolidating said first and second data records where said probability exceeds a predetermined level.

25. A method according to any one of Claims 14-24, wherein said first data record and said second data record are contained within the same database.

26. A method according to any one of Claims 14-24, wherein said first data record and said second data record are contained in different databases.

27. A method according to any one of Claims 14-26, comprising:

- for each data record generating a comparative set of comparative data items, and

- performing said consolidating responsive to a match of a sufficient number of data items in the comparative set between the two personal data records.

28. A method according to Claim 27, wherein said comparative data items in the comparative set are represented in a linear or a two dimensional matrix of comparative data items.

29. A method according to Claim 28, wherein the data items of the comparative set are represented as a computer-generated string sequence comprising a predefined set of building blocks organized in predefined sequence order.

30. A method according to any one of Claims 14-29, wherein at least one sub-record comprises information related to a first person and at least one other sub-record comprises information related to a second person.

31. A method according to any one of Claims 14-30, wherein the sub-records in the comparative data item comprise names of persons related to the first person.

32. A method for computerized management of a plurality of family trees, each family tree having a plurality of nodes, each of which represents a first person with associated personal data record, the method comprising:

for each personal data record, assigning one or more sub-records to one or more second persons relating to said first person, the sub-records comprising data on the second persons and their relationship to the first person;

comparing the personal data records with the personal data records from the plurality of family trees and identifying at least two trees that comprises each a predefined number of common nodes that represents the same individual, the identification comprises determining existence of matching comparative data items in the personal data records associated with the nodes, the comparative data items comprising data from one or more sub-records; and

merging said at least two trees with one another to yield a merged family tree which comprises the nodes of said at least two trees.

33. A computerized method of consolidating personal data records of persons comprising:

(a) in a computerized manner generating a person identifier for each person, the generation comprises generating a predefined set of building blocks organized in predefined sequence order, wherein said building blocks hold information derived from corresponding personal data records in accordance with one or more predefined rules;

(b) locating two or more personal data records where the level of identity of said building blocks indicates that said two or more data records are of the same person; and

(c) consolidating said two or more data records.

34. A method for merging a first family tree to a second family tree, comprising:

(a) providing a plurality of first matrices associated with the first family tree and a plurality of second matrices associated with the second family tree, each matrix comprising attributes on individuals that are linked to one another by a predetermined link;

(b) identifying substantially identical first and second matrices in said pluralities of first and second matrices; and

(c) generating data indicative of a merge of the family trees to one another if a number of the substantially identical matrices exceeds a predefined number.

35. A method according to claim 34, wherein each matrix includes attributes on individuals with a direct family link.

36. A method according to Claim 34 or 35, wherein the attributes are arranged in a predefined linear sequence.

37. A method according to Claim 36, wherein each attribute is given a numerical so as to define a vector for each sequence, and step (b) comprise searching for substantially identical first and second vectors.

38. A system for computerized consolidation of data records among plurality of data records, each of the data records comprising a main record on a first object and at least one sub-record assigned to a second object related to the first object, the system comprising a processor utility configured for the performance of the method according to any one of Claims 1-13.

39. A system for computerized consolidation of data records among plurality of data records, each of the data records comprising a main record on a first object and at least one sub-record assigned to a second object related to the first object, the system comprising:

a processor utility configured to process data indicative of said data records, to determine a match between one or more comparative data items each of which consisting of a sub-record or comprising a characteristic part of a sub-record, and (iii) responsive to deteraiining the match of one or more comparative data items, generating data indicative thereof enabling consolidating the first and the one or more second data items; and

a storage utility for storing the consolidated data records.

40. A system for computerized consolidation of personal data records among plurality of personal data records, each of the personal data records comprising a main

record on a first object and at least one sub-record assigned to a second person related to the first person, the system comprising:

a processor utility configured to (i) process data indicative of the personal data records, for determining a match between one or more comparative data items each of which consisting of a sub-record or comprising a characteristic part of a sub-record, and (iii) responsive to determining match of one or more comparative data items, generating data indicative thereof enabling consolidating the first and the one or more second data items; and

a storage utility for storing the consolidated data records.

41. A system according to Claim 39 or 40, comprising:

a subsystem configured to comparing a first set of data records with a second set of data records; and

a subsystem configured to consolidate the first set and the second set responsive to determining a plurality of identical sub-records in the first and second set.

42. A system according to Claim 39 or 40, for carrying out the method of any one of Claims 14-37.

43. A program storage device readable by machine, tangibly embodying a program of instructions executable by the machine to perform a method according to any one of Claims 1-37.

44. A database of consolidated data records obtained by the method of any one of Claims 1-37.

45. A method for computerized management of at least two family trees, each family tree being identified by a plurality of relationship sequences, the method comprising:

(a) identifying at least one first family tree of said at least two family trees having at least one matching sequence with at least one second family tree of said at least two family trees; and

(b) merging said at least one first family tree to said at least one second family tree into one consolidated family tree.

46. A method according to Claim 45, wherein the family tree comprises nodes, each one representing an individual, and connecting lines between the nodes, a relationship sequence consisting of at least two nodes and the lines connecting them.

47. A method according to Claim 45 or 46, comprising merging the family trees upon identification of one or more sequences comprising at least two nodes.

48. A method according to any one of Claims 45-47, wherein two family trees are merged where said at least one matching sequence comprises, in combination, at least a predetermined number of nodes and connecting lines between them.

49. A method according to any one of Claims 48, wherein said predetermined number is 2.

50. A method according to any one of Claims 48, wherein said predetermined number is 6.

51. A method according to any one of Claims 45-50, wherein said at least one matching sequence comprises at least a predetermined number of sequences each comprising a sequence pair, each said pair consists of two nodes and a connecting line between them.

52. A method according to any one of Claims 45-51, wherein said identifying is performed automatically by a computer system.

53. A method according to any one of Claims 45-52, wherein said identifying is performed upon a request by a user constructing a family tree.

54. A method according to any one of Claims 45-53, wherein said merging is automatic.

55. A method according to any one of Claims 45-53, wherein said merging is upon user selection.

56. A system for computerized management of at least two family trees, each family tree being identified by a plurality of relationship sequences, the system comprising:

a computer system configured as a server system accessible by users of a computer network, the computer system comprising a processor utility configured and operable for processing data in a database of family trees of multiple persons and upon identifying in at least two family at least one matching sequence generating data indicative thereof enabling merging said at least two family trees into one consolidated family tree.

57. A system according to Claim 56, for carrying out the method of any one of Claims 45-55.

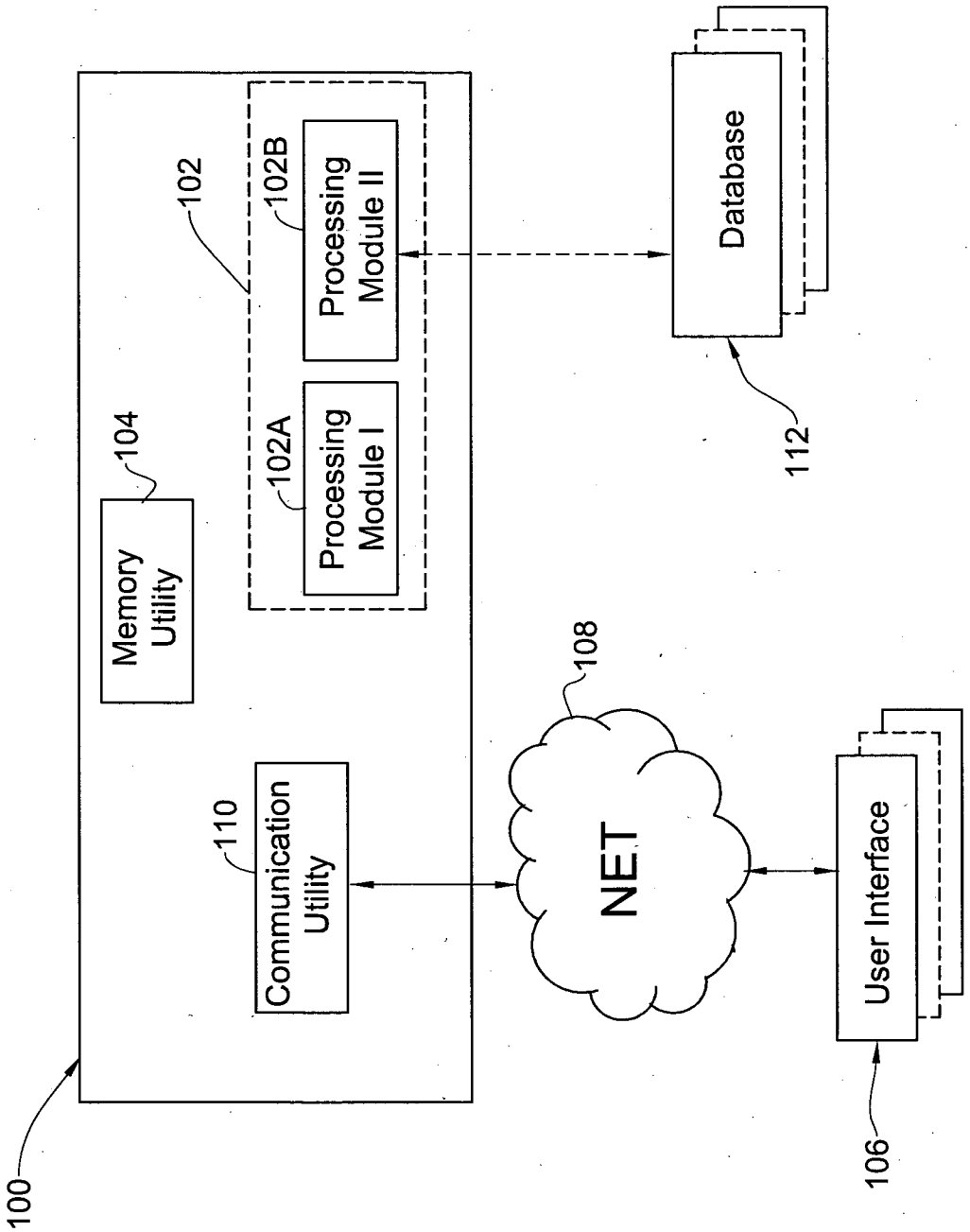

100
102
102A
Processing Module I
102B
Processing Module II
104
Memory Utility
110
Communication Utility
108
NET
106
User Interface
112
Database

Figure 1A

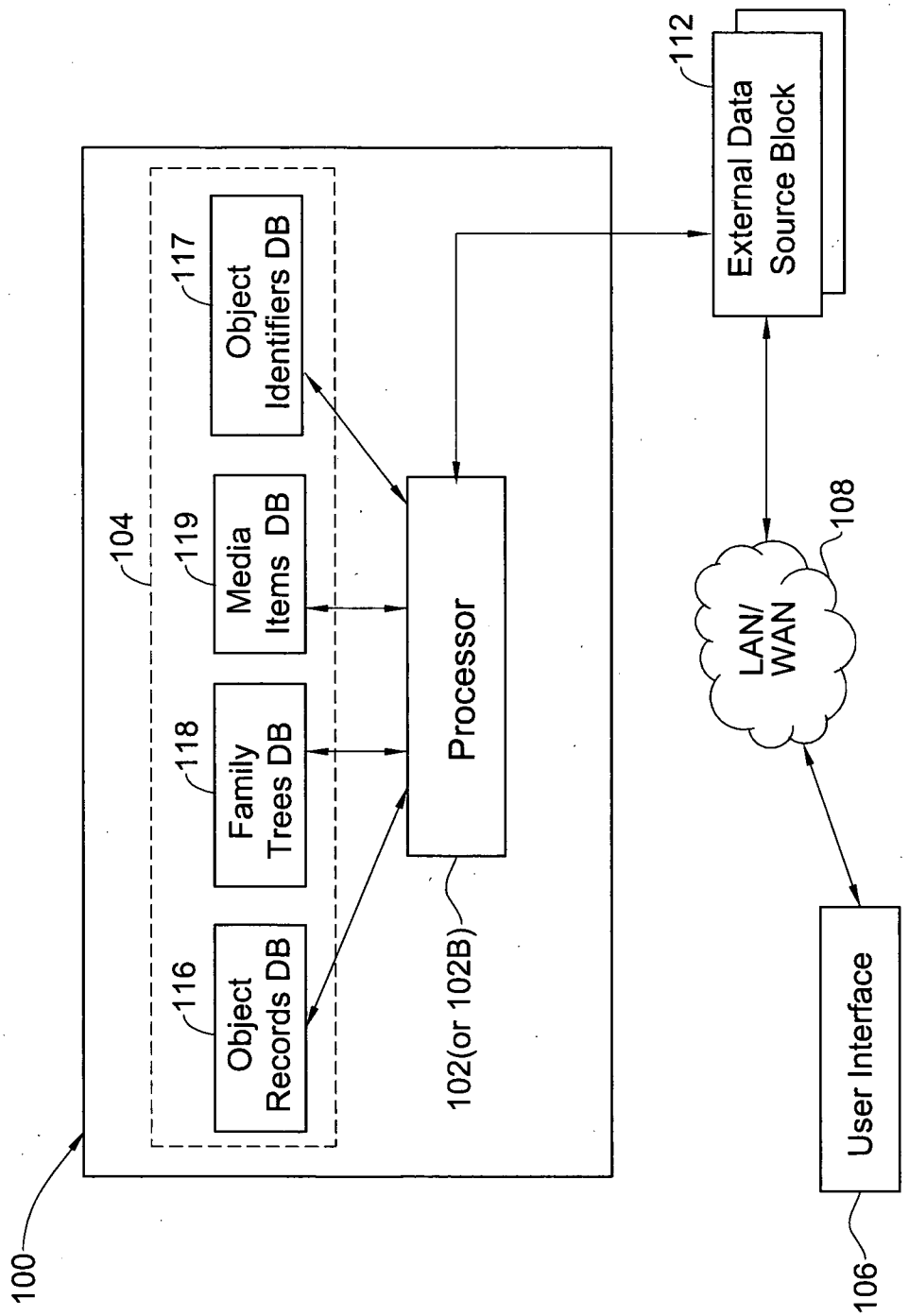

100
104
Object Identifiers DB
117
Media Items DB
119
Family Trees DB
118
Object Records DB
116
Processor
102(or 102B)
112
External Data Source Block
LAN/ WAN
108
User Interface
106

Figure 1B

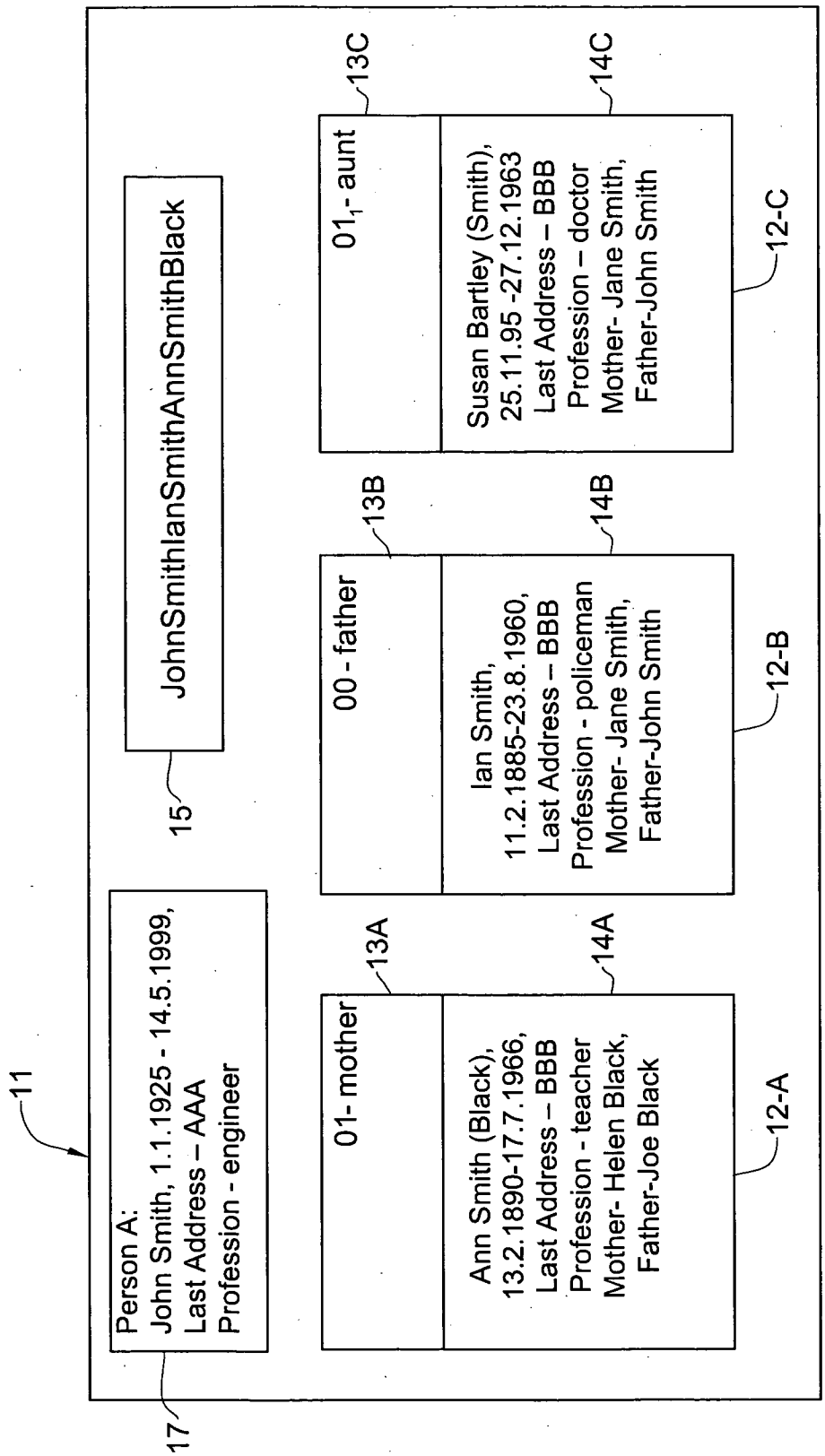

11
Person A:
John Smith, 1.1.1925 - 14.5.1999,
Last Address – AAA
Profession - engineer
17
15
JohnSmithIanSmithAnnSmithBlack
01- mother
13A
Ann Smith (Black),
13.2.1890-17.7.1966,
Last Address – BBB
Profession - teacher
Mother- Helen Black,
Father-Joe Black
14A
12-A
00 - father
13B
Ian Smith,
11.2.1885-23.8.1960,
Last Address – BBB
Profession - policeman
Mother- Jane Smith,
Father-John Smith
14B
12-B
01$_1$- aunt
13C
Susan Bartley (Smith),
25.11.95 -27.12.1963
Last Address – BBB
Profession – doctor
Mother- Jane Smith,
Father-John Smith
14C
12-C

Figure 2

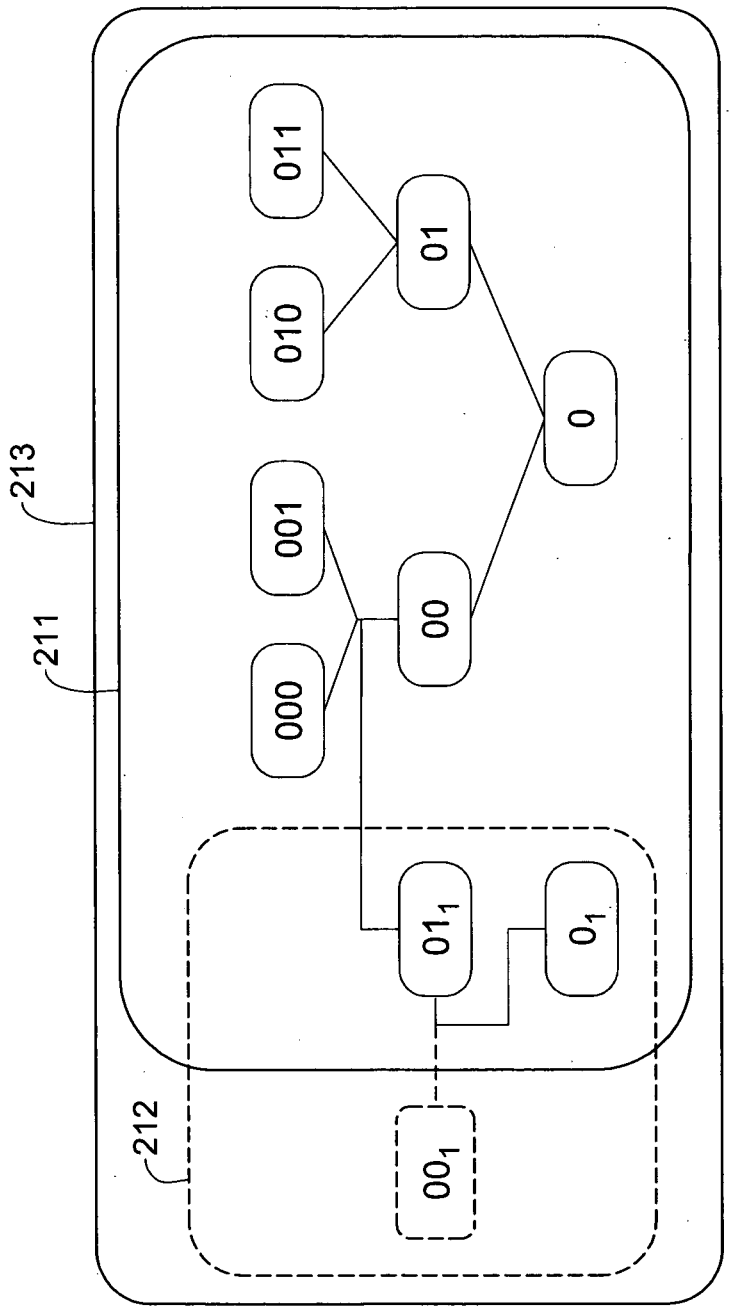


Figure 3

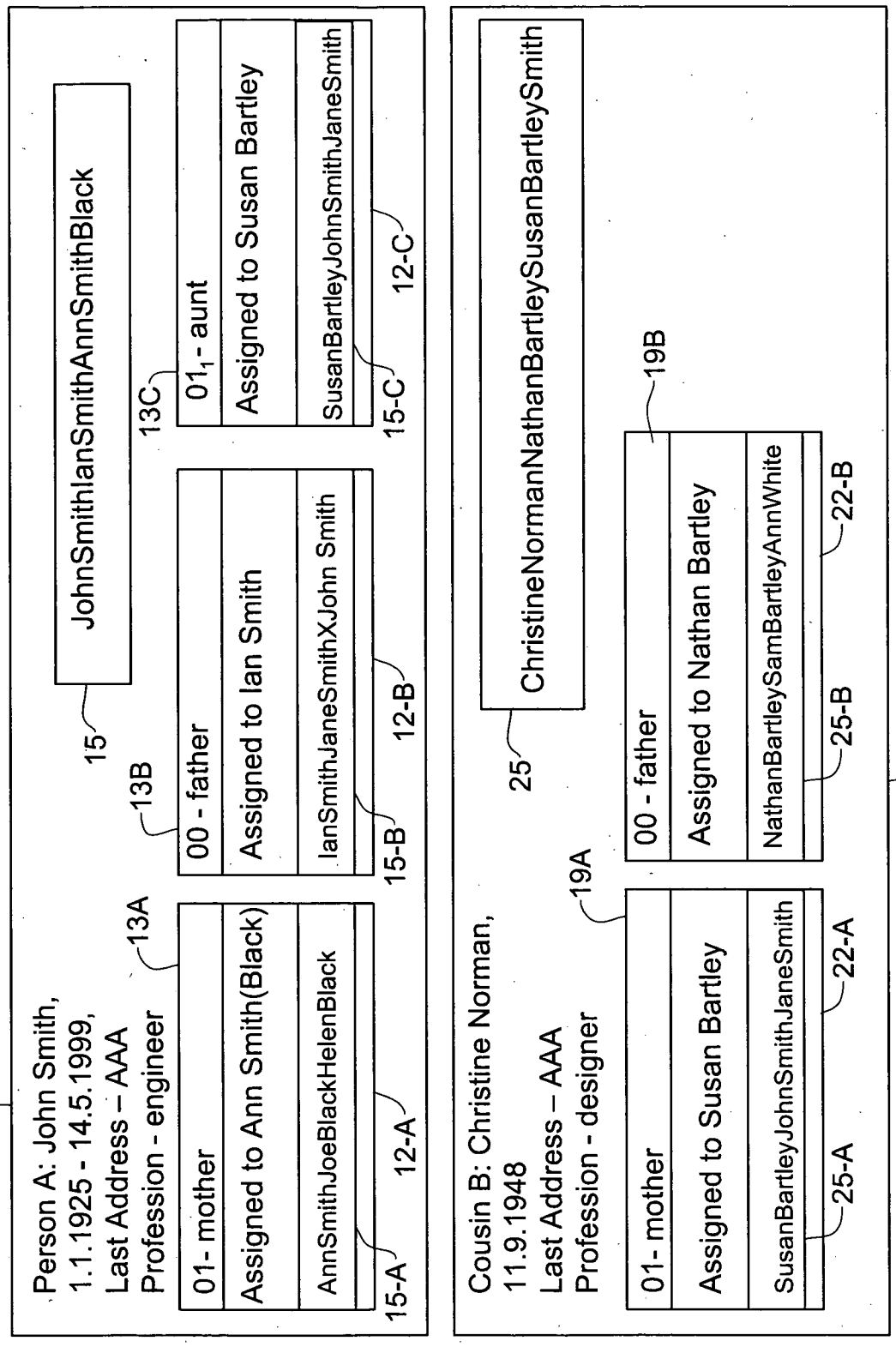
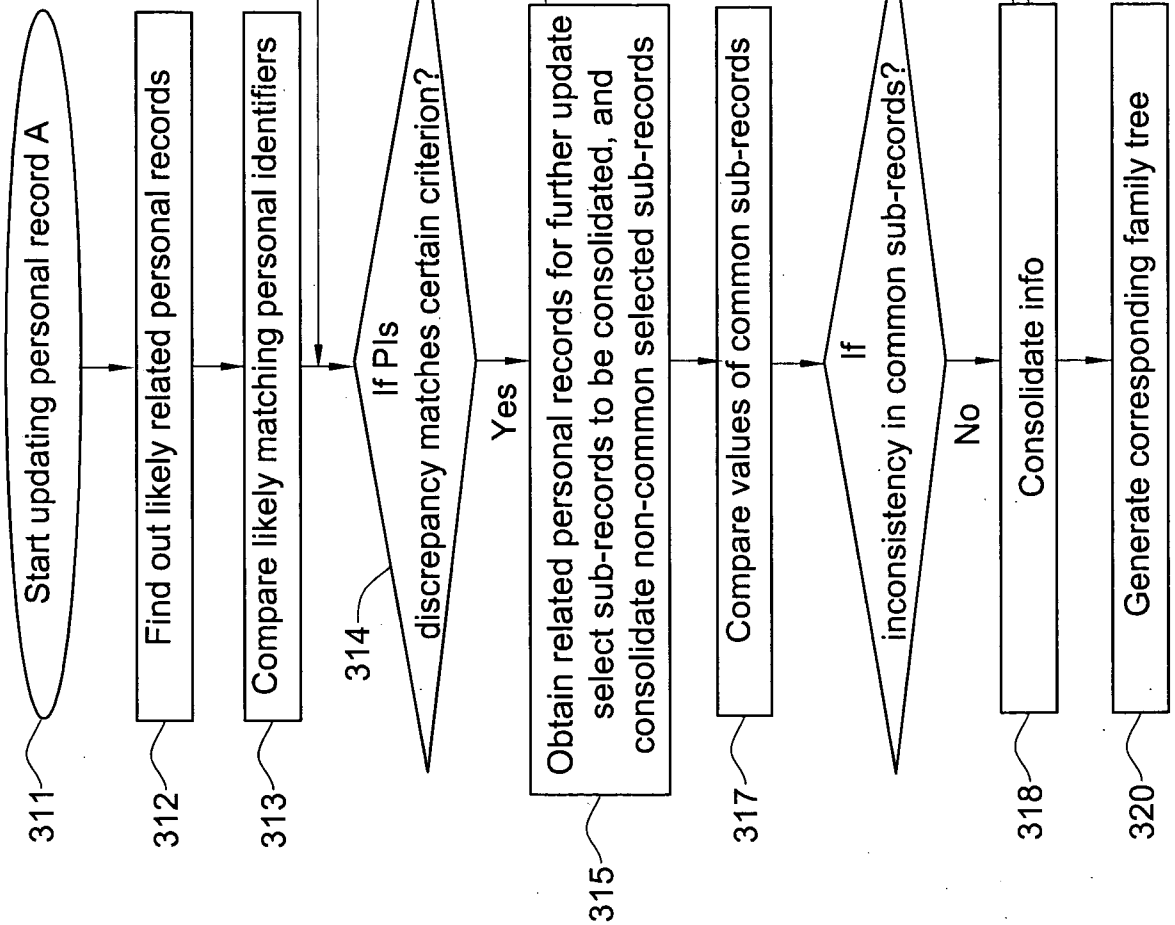

11
Person A: John Smith,
1.1.1925 - 14.5.1999,
Last Address – AAA
Profession - engineer
13A
01- mother
Assigned to Ann Smith(Black)
AnnSmithJoeBlackHelenBlack
15-A
12-A
15
JohnSmithIanSmithAnnSmithBlack
13B
00 - father
Assigned to Ian Smith
IanSmithJaneSmithXJohn Smith
15-B
12-B
13C
01$_1$- aunt
Assigned to Susan Bartley
SusanBartleyJohnSmithJaneSmith
15-C
12-C
Cousin B: Christine Norman,
11.9.1948
Last Address – AAA
Profession - designer
19A
01- mother
Assigned to Susan Bartley
SusanBartleyJohnSmithJaneSmith
25-A
22-A
25
ChristineNormanNathanBartleySusanBartleySmith
19B
00 - father
Assigned to Nathan Bartley
NathanBartleySamBartleyAnnWhite
25-B
22-B
21

Figure 4

Figure 5A


Start updating personal record A
311
Find out likely related personal records
312
Compare likely matching personal identifiers
313
If PIs discrepancy matches certain criterion?
314
No
Request for additional info
316-2
Request for authorization
316-1
Yes
Obtain related personal records for further update select sub-records to be consolidated, and consolidate non-common selected sub-records
315
Compare values of common sub-records
317
If inconsistency in common sub-records?
Yes
If contradiction in common sub-records?
Yes
No
Select prioritized source or request authorization
319
If selected/authorized?
Yes
No
Consolidate info
318
Generate corresponding family tree
320

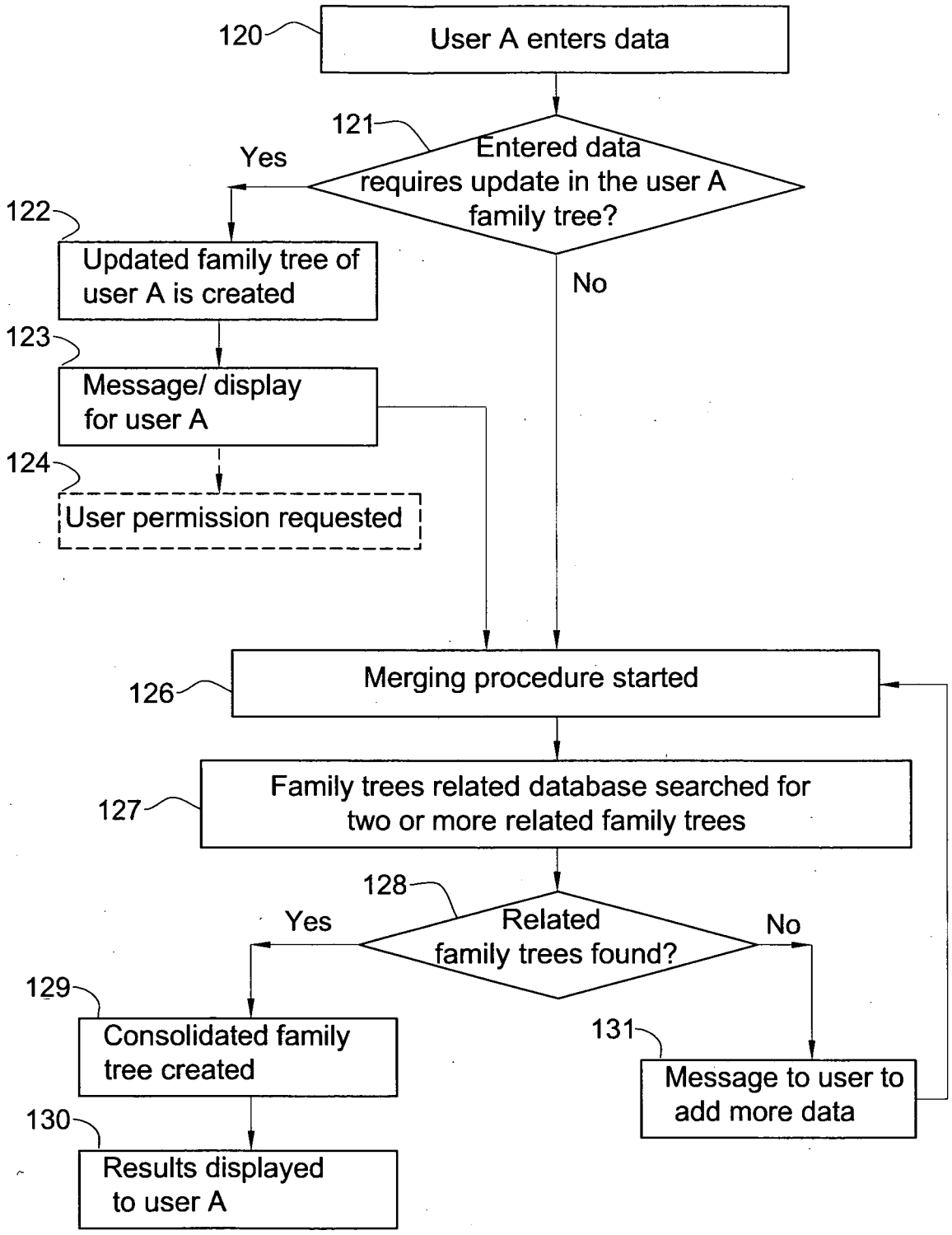

120
User A enters data
121
Entered data requires update in the user A family tree?
Yes
No
122
Updated family tree of user A is created
123
Message/ display for user A
124
User permission requested
126
Merging procedure started
127
Family trees related database searched for two or more related family trees
128
Related family trees found?
Yes
No
129
Consolidated family tree created
130
Results displayed to user A
131
Message to user to add more data

Figure 5B

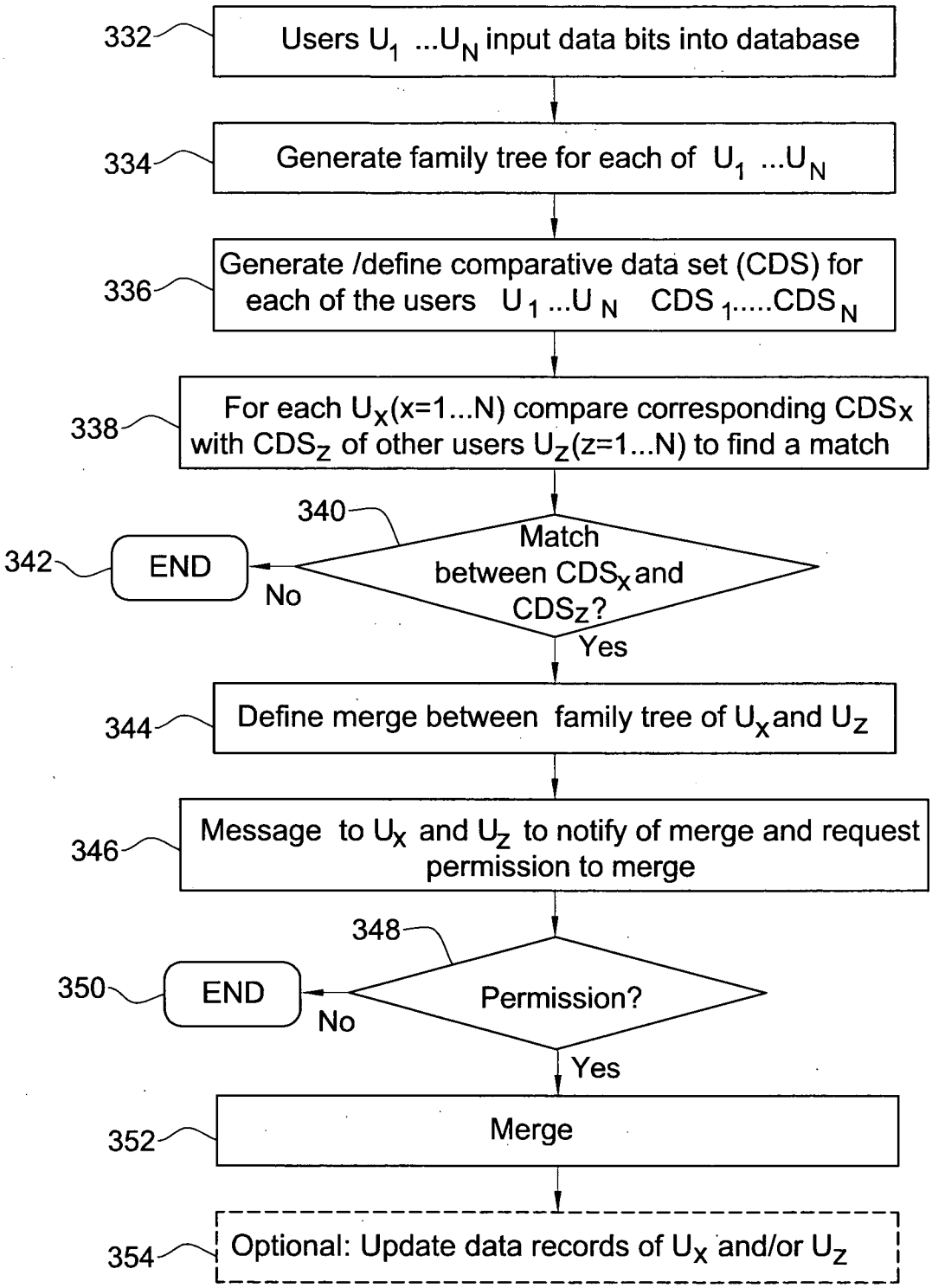

332
Users U_1 ...U_N input data bits into database
334
Generate family tree for each of U_1 ...U_N
336
Generate /define comparative data set (CDS) for each of the users U_1 ...U_N CDS_1.....CDS_N
338
For each U_X(x=1...N) compare corresponding CDS_X with CDS_Z of other users U_Z(z=1...N) to find a match
340
Match between CDS_X and CDS_Z?
342
END
No
Yes
344
Define merge between family tree of U_X and U_Z
346
Message to U_X and U_Z to notify of merge and request permission to merge
348
Permission?
350
END
No
Yes
352
Merge
354
Optional: Update data records of U_X and/or U_Z

Figure 5C

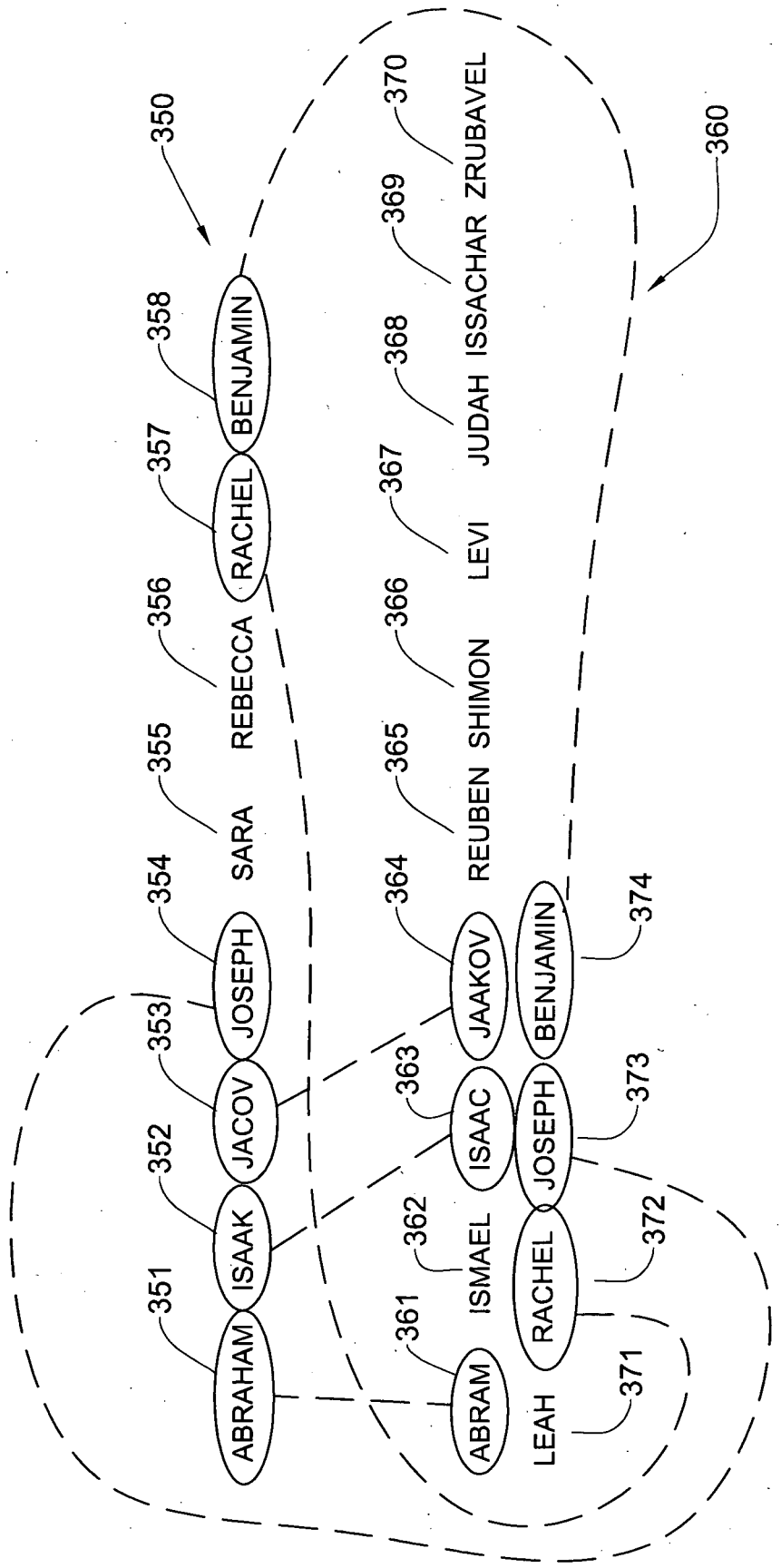

350
360
351
ABRAHAM
352
ISAAK
353
JACOV
354
JOSEPH
355
SARA
356
REBECCA
357
RACHEL
358
BENJAMIN
361
ABRAM
362
ISMAEL
363
ISAAC
364
JAAKOV
365
REUBEN
366
SHIMON
367
LEVI
368
JUDAH
369
ISSACHAR
370
ZRUBAVEL
371
LEAH
372
RACHEL
373
JOSEPH
374
BENJAMIN

Figure 6

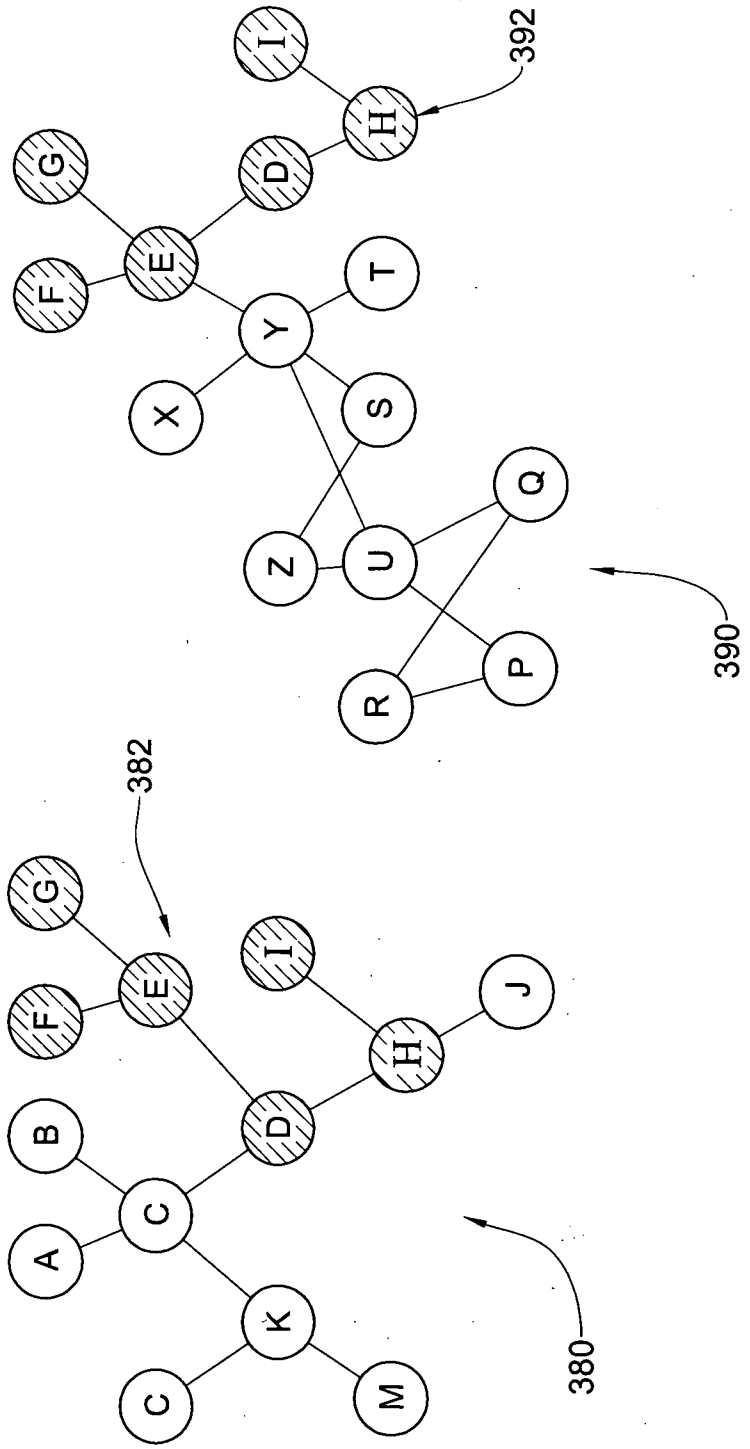


Figure 7

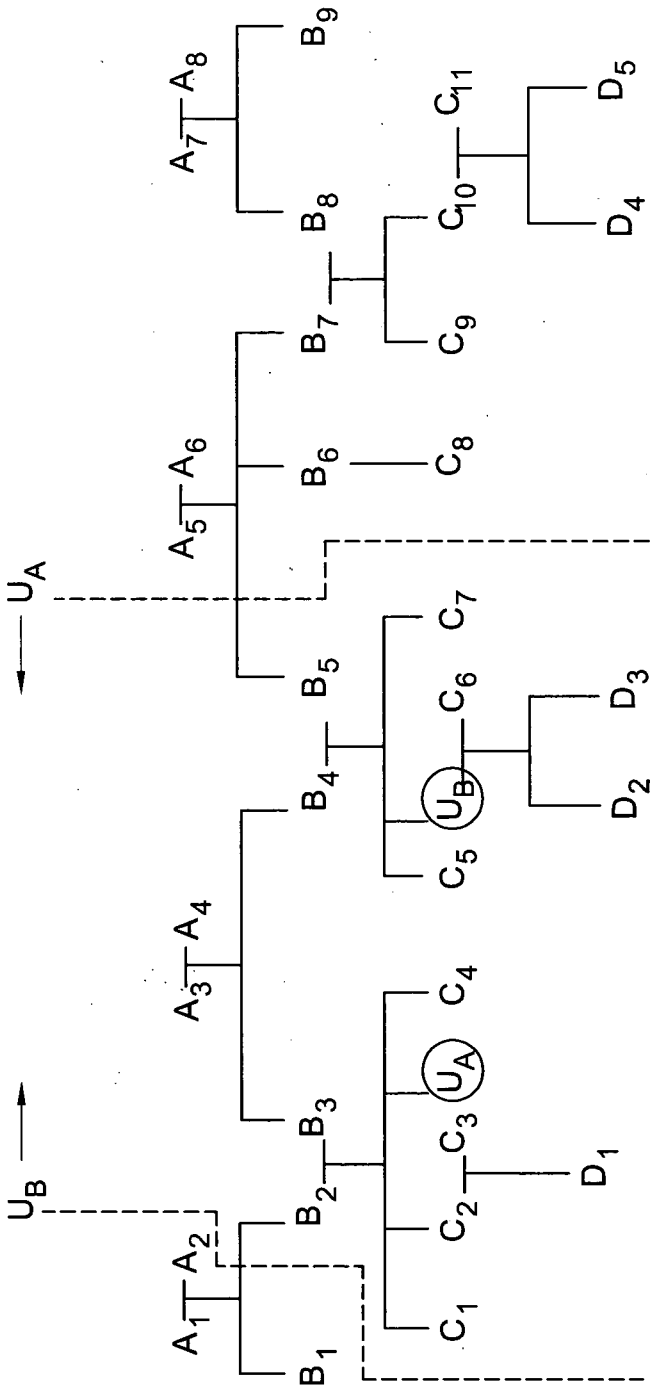

U_A
U_B
A_1
A_2
A_3
A_4
A_5
A_6
A_7
A_8
B_1
B_2
B_3
B_4
B_5
B_6
B_7
B_8
B_9
C_1
C_2
C_3
C_4
C_5
C_6
C_7
C_8
C_9
C_{10}
C_{11}
D_1
D_2
D_3
D_4
D_5

Figure 8A

U_A-B_2-B_3-C_1-C_2-C_4-C_3-D_1-A_1-A_2-A_3-A_4-B_1-B_4-B_5-C_5-U_B-C_7-C_6-D_2-D_3

U_B-B_4-B_5-C_6-D_2-D_3-C_5-C_7-A_3-A_4-A_5-A_6-B_3-B_2-C_1-C_2-U_A-C_4-C_3-D_1-B_6-C_8-B_8-C_9-C_{10}-C_{11}-D_4-D_5-A_7-A_8-B_9

Figure 8B

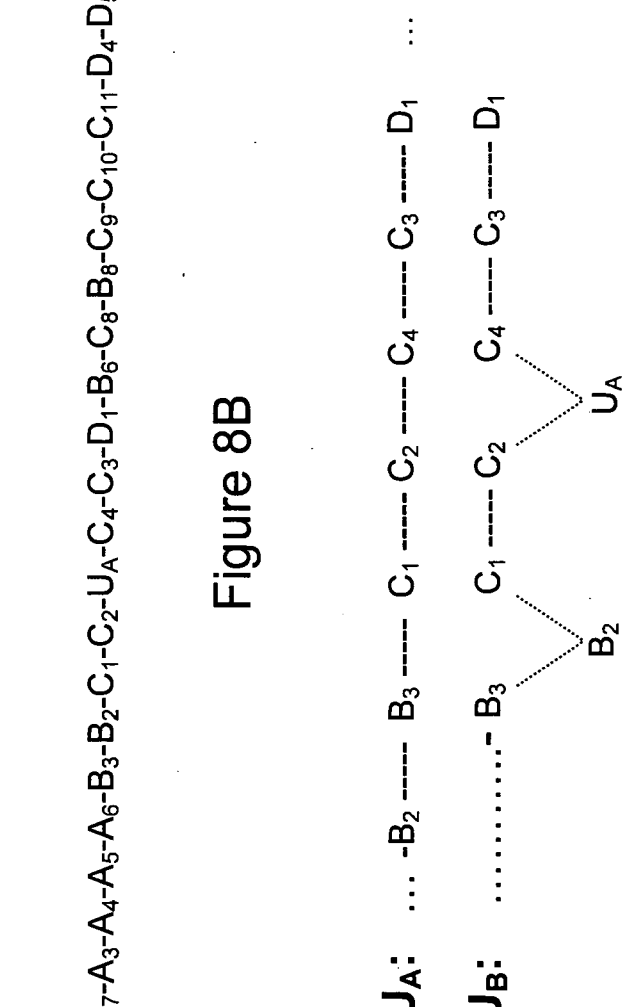


Figure 8C

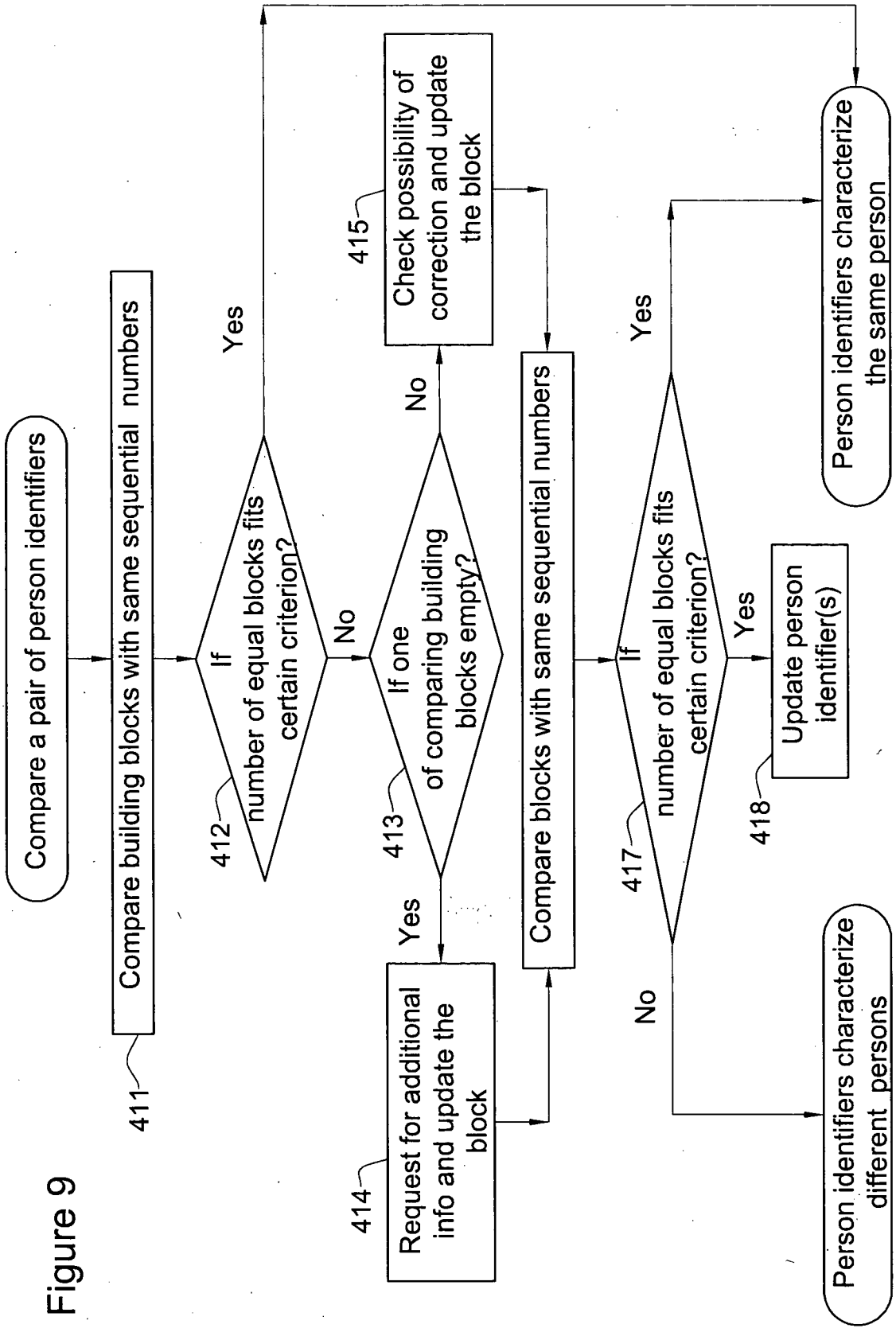

Compare a pair of person identifiers
Compare building blocks with same sequential numbers
411
If number of equal blocks fits certain criterion?
412
Yes
No
If one of comparing building blocks empty?
413
No
Yes
Check possibility of correction and update the block
415
Request for additional info and update the block
414
Compare blocks with same sequential numbers
If number of equal blocks fits certain criterion?
417
Yes
No
Update person identifier(s)
418
Person identifiers characterize the same person
Person identifiers characterize different persons

Figure 9

PATENT COOPERATION TREATY

PCT

DECLARATION OF NON-ESTABLISHMENT OF INTERNATIONAL SEARCH REPORT

(PCT Article 17(2)(a), Rules 13ter.1 (c) and Rule 39)

Applicant's or agent's file reference	IMPORTANT DECLARATION	Date of mailing *(day/month/year)*
17275 1.0 YS		07/02/2 008
International application No.	International filing *daïe(day/month/yβar)*	(Earliest) Priority date *(day/month/year)*
PCT/IL2 007 /001341	04/11/2007	02/11/2006
International Patent Classification (IPC) or both national classification and IPC		
G06P17/3 0		
Applicant		
FAMILLION LTD .		

This International Searching Authority hereby declares, according to Article 17(2)(a), that **no international search report will be established** on the international application for the reasons indicated below

1. Q] The subject matter of the international application relates to:

a. Q] scientific theories

b. Q] mathematical theories

c. [ ] plant varieties

d. Q] animal varieties

e. [ ] essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes

f. Q] schemes, rules or methods of doing business

g. Q] schemes, rules or methods of performing purely mental acts

h. Q] schemes, rules or methods of playing games

i. Q] methods for treatment of the human body by surgery or therapy

j. [Q] methods for treatment of the animal body by surgery or therapy

k. Q] diagnostic methods practised on the human or animal body

l. Q] mere presentations of information

m. [ ] computer programs for which this International Searching Authority is not equipped to search prior art

2- \x\ The failure of the following parts of the international application to comply with prescribed requirements prevents a meaningful search from being carried out:

[ ] the description \X\ the claims Q j the drawings

3- Q] A meaningful search could not be carried out without the sequence listing; the applicant did not, within the prescribed time limit:

[ ] furnish a sequence listing on paper complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in a form and manner acceptable to it.

[ ] furnish a sequence listing in electronic form complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in a form and manner acceptable to it.

[ ] pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13fer.1(a) or (b).

4. Q] A meaningful search could not be carried out without the tables related to the sequence listings; the applicant did not, within the prescribed time limit, furnish such tables in electronic form complying with the technical requirements provided for in Annex *C-bis* of the Administrative Instructions, and such tables were not available to the International Searching Authority in a form and manner acceptable to it.

5. Further comments: see annex

Name and mailing address of the International Searching Authority	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Katrin Soitimermeyer

Form PCT/ISA/203 (April 2005)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

1. The present application contains 57 claims. Of these claims are 12 drafted as independent claims. The independent method claims are claims 1, 14, 32, 33, 34, and 45. The independent system claims are claims 38, 39, 40, and 56. There is an independent claim to a database (claim 44) and an independent claim to a program storage device (claim 43).

There is no clear distinction between the independent claims because of overlapping scope. There are so many claims, and they are drafted in such a way that the claims as a whole are not in compliance with the provisions of clarity and conciseness of Article 6 PCT, as it is particularly burdensome for a skilled person to establish the subject-matter for which protection is sought.

The reasons are as follows: The independent and dependent claims appear to be essentially directed to a large number of variations concerning data matching for data merging/consolidation purposes. The different independent claims differ in their features and also in the features of their dependent claims. The wording of the independent claims is unclear, because it uses unclear and vague terminology such as main record, sub-record, first object, second object related to the first object, etc. Evidently, for record matching the details of the matching method are critical for defining the scope of a search, because record matching as such is commonplace. Unfortunately none of the independent claims does specify a clear match algorithm, which could be used to define a meaningful scope of the search. Rather most claims refer simply to matching "comparative data items". This is entirely general and worded as a result to be achieved without specifying the means or steps necessary in order to achieve the matching.

In view of this the claims erect a smoke screen which makes it impossible to know to which subject matter a search could be restricted.

2. The non-compliance with the substantive provisions is to such an extent that a meaningful search of the whole claimed subject-matter could not be carried out (Article 17(2) PCT and PCT Guidelines 9.30).

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

There being no reasonable basis in the application that clearly indicates the subject-matter which might be expected to form the subject of the claims later in the procedure, no search at all was deemed possible.

The description comprises 39 pages containing a large number of fall back positions covering many different alternative approaches. While the application mentions at several places that the claimed invention can be applied in different application contexts, the preferred, non-limiting embodiments appear to be directed to the matching and merging of family trees. However, there is not a single preferred method or system described, but rather a set of methods and systems which could be used alternatively and in combination with further variations for matching. Some of these are listed below:

- a matching based on the topology of the trees (see e.g. Fig. 7 and passage starting on page 32, line 17)
- a matching using a linear string of personal identifiers (see e.g. page 33, last paragraph)
- a matching using a plurality of vectors (see page 34, last paragraph)
- a matching using short-relationship defining sequences (see page 35, paragraph 2)
- matching strings of personal identifiers with phonetic algorithms (see page 31, last paragraph)
- matching personal data records using predefined building blocks in a predefined sequence as shown in Fig 9 and the corresponding passages of the description, including various variations for correcting missing or erroneous data.

It is furthermore noted that the application did not discuss any technical effects of these different methods. While the application mentions a list of prior art documents, the application does not contain a discussion of the problem(s) solved by the claimed subject matter over these documents nor an indication of any advantages.

The applicant's attention is drawn to the fact that claims relating to

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) PCT declaration be overcome .