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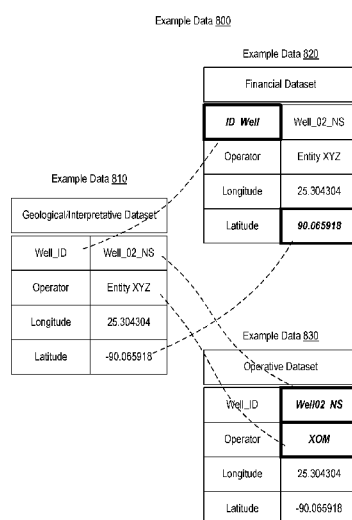
(54) **Title:** WELL ANALYTICS FRAMEWORK

Fig. 8

(57) **Abstract:** A method can include receiving a selected item and selected characteristics; analyzing other items with respect to the selected item and the selected characteristics to generate analysis results; and rendering a graphical user interface to a display that includes at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics where the graphical user interface includes a comparison control actuatable to perform a comparison between at least two of the items.



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WELL ANALYTICS FRAMEWORK

RELATED APPLICATION

[0001] This application claims priority to and the benefit of a US Provisional Application having Serial No. 62/158,904, filed 8 May 2015, which is incorporated by reference herein.

BACKGROUND

[0002] Various types of modules, frameworks, etc., exist for modeling, analyzing, etc., geological formations, reservoirs, sedimentary basins, etc. Various examples of methods, devices, systems, etc., are described herein that may pertain to such technologies.

SUMMARY

[0003] A method can include receiving a selected item and selected characteristics. The method may also involve analyzing other items with respect to the selected item and the selected characteristics to generate analysis results. It may further involve rendering a graphical user interface to a display that includes a portion of the analysis results organized with respect to the selected item and a portion of the other items and at least one of the characteristics where the graphical user interface includes a comparison control actuatable to perform a comparison between at least two of the items. A system can include processors and memory operatively coupled to the processors, and instructions stored in the memory and executable by the processors. These instructions may instruct the system to receive a selected item and selected characteristics, analyze other items with respect to the selected item and the selected characteristics to generate analysis results, and render a graphical user interface to a display. The graphical user interface may include a portion of the analysis results organized with respect to the selected item and a portion of the other items and at least one of the characteristics. The graphical user interface can include a comparison control actuatable to perform a comparison between at least two of the items.

[0004] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to

identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Features and advantages of the described implementations can be more readily understood by reference to the following description taken in conjunction with the accompanying drawings.

[0006] Fig. 1 illustrates an example system that includes various components for simulating a geological environment;

[0007] Fig. 2 illustrates an example of a system;

[0008] Fig. 3 illustrates an example of a method;

[0009] Fig. 4 illustrates an example of a graphical user interface;

[0010] Fig. 5 illustrates an example of a graphical user interface;

[0011] Fig. 6 illustrates an example of a graphical user interface;

[0012] Fig. 7 illustrates an example of a graphical user interface;

[0013] Fig. 8 illustrates example data;

[0014] Fig. 9 illustrates an example of a graphical user interface;

[0015] Fig. 10 illustrates an example of a graphical user interface;

[0016] Fig. 11 illustrates an example of a graphical user interface;

[0017] Fig. 12 illustrates an example of a method and an example of a system; and

[0018] Fig. 13 illustrates example components of a system and a networked system.

DETAILED DESCRIPTION

[0019] The following description includes the best mode presently contemplated for practicing the described implementations. This description is not to be taken in a limiting sense, but rather is made merely for the purpose of describing the general principles of the implementations. The scope of the described implementations should be ascertained with reference to the issued claims.

[0020] Resource exploration and development can generate various types of data. For example, consider data associated with modeling of a geologic environment, data associated with planning a well, data associated with drilling a

well, data associated with production of fluid from the well, etc. As an example, a geologic environment may include a number of wells where associated data may be stored in one or more data stores. As an example, data stores may exist for many geologic environments where such environments may be developed, undeveloped, partially developed, etc.

[0021] As an example, a system can provide for analyzing data associated with one or more geologic environments. For example, consider a system that provides for selection of an item and analyzing data to determine if similar items exist as may be associated with the one or more geologic environments. Such a system may facilitate analysis of a particular item, which may be, for example, a well, a piece of equipment, a feature in a geologic environment, etc. For example, consider a system that can render a graphical user interface (GUI) that includes information as to a plurality of items with respect to a selected item where the information indicates a degree of similarity and/or dissimilarity of the items with respect to the selected item. Such a system may allow for further analysis, for example, for comparisons of particular data of items.

[0022] As an example, a model of a geologic environment may be built based at least in part on acquired data (e.g., seismic data, borehole logs, etc.) where the model can represent items (e.g., wells, equipment, subterranean features, etc.). As an example, such a model may be a simulation model, for example, to simulate one or more physical phenomena (e.g., geomechanics, fluid flow, petroleum systems, etc.). As an example, a model may be a way of structuring data, for example, where such data may facilitate economic or other analyses (e.g., optionally without simulation of physical phenomena).

[0023] As an example, an amount of accessible data may be considerable. As an example, data may be quantitative, qualitative or both quantitative and qualitative. As an example, data may be stored in one or more data stores, which may be considered data sources. As an example, data may be communicated (e.g., transmitted) optionally without storage in a data store. As an example, consider a field sensor that transmits data continuously, periodically or on-demand. Such a sensor may be considered as providing data and thereby be a data source.

[0024] As an example, the value of data may be enhanced via aggregation, classification, etc. As an example, data may have one or more associated attributes

that characterize the data, for example, consider data characterized by type of data (e.g., sensor data, simulation data, production data, interpretative data, geological data, economic data, etc.). As an example, a search engine may be configured to access data based on one or more values, attributes, etc. For example, a search engine may perform a search based at least in part on indexed data values, data attributes, etc., which may facilitate searches. For example, an index or indexes may be generated for data, optionally where the data may be available from multiple sources, where the data includes data available from multiple sources, etc.

[0025] As an example, search results returned by a search engine that performs a search based on one or more search criteria may be presented as items in a table, for example, as items of a list. In such an example, the order of the items in the list may be based, for example, on relevance with respect to a search criterion or search criteria, numerical order, or alphabetical order.

[0026] As an example, a framework that can organize models and associated data (e.g., model data, field data, etc.) as projects may include features for analyzing one or more items, which may optionally include one or more items in search results. As an example, a framework may generate a graphical user interface (GUI) that can be utilized to select one or more items, analyze one or more items, compare one or more items, etc. As an example, a framework may allow a user to select one or more items of a project and, for example, one or more characteristics. As to characteristics, as an example, consider one or more of geological, interpretative, financial and operative characteristics.

[0027] As an example, a graphical user interface (GUI) may be rendered to a display, for example, upon execution of code, where the GUI includes one or more graphical controls. For example, such a GUI may include a graphical control that provides characteristics that can be selectable, for example, where individual characteristics may be selectable via check boxes, radio buttons, a dropdown menu, dragging and dropping, etc.

[0028] As an example, a GUI may include a graphical control for selection of one or more items to be analyzed. For example, a GUI can include a panel that lists search results associated with one or more projects where a menu may be rendered responsive to highlighting one of the items in the search results where the menu includes an option to analyze additional items as to, for example, similarity and/or

dissimilarity. In such an example, upon receipt of a command to analyze an item, a GUI may be rendered that includes information associated with an analysis and, for example, one or more graphical controls for performing further analysis or analyses. For example, consider a graphical control that allows for comparison of items and/or a graphical control that allows for uncovering one or more additional items (e.g., based on one or more resolution criteria, etc.).

[0029] As an example, a search tool can provide for returning data (e.g., exploration and production data “E&P data”) such as, for example, wells and seismic objects (e.g., as entities in a model, entities in a field, etc.), which may be considered to be items. As an example, search results may be visualized in one or more 2D/3D canvases (e.g., panels rendered to a display) and, for example, optionally in a table viewer (e.g., in a table format). As an example, one or more search results (e.g., one or more items) may be analyzed with respect to other items according to one or more characteristics.

[0030] As an example, a framework may be operatively coupled to a search engine that can provide for searching one or more data stores (e.g., databases, etc.). As an example, the STUDIO E&P™ knowledge environment (Schlumberger Ltd., Houston, Texas) includes STUDIO FIND™ search functionality, which provides a search engine. The STUDIO FIND™ search functionality also provides for indexing content, for example, to create one or more indexes. As an example, search functionality may provide for access to public content, private content or both, which may exist in one or more databases, for example, optionally distributed and accessible via an intranet, the Internet or one or more other networks. As an example, a search engine may be configured to apply one or more filters from a set or sets of filters, for example, to enable users to filter out data that may not be of interest.

[0031] As an example, an analyzer may provide for analyzing one or more items. As an example, the PETREL® seismic-to-simulation framework (Schlumberger Ltd., Houston, Texas) may provide for interaction with an analyzer and, for example, a search engine that may include associated features such as features of the STUDIO FIND™ search functionality. As an example, a framework may provide for implementation of one or more spatial filters (e.g., based on an area viewed on a display, static data, etc.). As an example, a search may provide access

to dynamic data (e.g., “live” data from one or more sources, optionally including a GIS source), which may be available via one or more networks (e.g., wired, wireless, etc.).

[0032] Fig. 1 shows an example of a system 100 that includes various management components 110 to manage various aspects of a geologic environment 150. For example, the management components 110 may allow for direct or indirect management of sensing, drilling, injecting, extracting, etc., with respect to the geologic environment 150. In turn, further information about the geologic environment 150 may become available as feedback 160 (e.g., optionally as input to one or more of the management components 110).

[0033] In the example of Fig. 1, the management components 110 include a seismic data component 112, an information component 114, a processing component 116, a simulation component 120, an attribute component 130, an analysis/visualization component 142 and a workflow component 144. In operation, seismic data and other information provided per the components 112 and 114 may be input to the simulation component 120.

[0034] In an example embodiment, the simulation component 120 may rely on entities 122. Entities 122 may include, for example, earth entities or geological objects such as wells, surfaces, reservoirs, etc. In the system 100, the entities 122 can include virtual representations of actual physical entities that are reconstructed for purposes of simulation. The entities 122 may include entities based on data acquired via sensing, observation, etc. (e.g., the seismic data 112 and other information 114). As an example, an entity may be an item and, for example, returnable by a search engine as a search results. For example, a search engine may be utilized to perform a search of entities where search results include entities, which may be considered to be items.

[0035] In an example embodiment, the simulation component 120 may rely on a software framework such as an object-based framework. In such a framework, entities may include entities based on pre-defined classes to facilitate modeling and simulation. A commercially available example of an object-based framework is the MICROSOFT® .NET™ framework (Redmond, Washington), which provides a set of extensible object classes. In the .NET™ framework, an object class encapsulates a module of reusable code and associated data structures. Object classes can be

used to instantiate object instances for use in by a program, script, etc. For example, borehole classes may define objects for representing boreholes, well classes may define objects for representing wells, etc. As mentioned an entity may be an item and, as such, an object in an object-based framework may be an item.

[0036] In the example of Fig. 1, the simulation component 120 may process information to conform to one or more attributes specified by the attribute component 130, which may include a library of attributes (e.g., including seismic attributes). Such processing may occur prior to input to the simulation component 120. Alternatively, or in addition to, the simulation component 120 may perform operations on input information based on one or more attributes specified by the attribute component 130. In an example embodiment, the simulation component 120 may construct one or more models of the geologic environment 150, which may be relied on to simulate behavior of the geologic environment 150 (e.g., responsive to one or more acts, whether natural or artificial). In the example of Fig. 1, the analysis/visualization component 142 may allow for interaction with a model or model-based results. Additionally, or alternatively, output from the simulation component 120 may be input to one or more other workflows, as indicated by a workflow component 144.

[0037] In an example embodiment, the management components 110 may include features of the PETREL® seismic-to-simulation software framework. The PETREL® framework provides components that can allow for optimization of exploration and development operations. The PETREL® framework includes seismic to simulation software components that can output information for use in increasing reservoir performance, for example, by improving asset team productivity. Through use of such a framework, various professionals (e.g., geophysicists, geologists, and reservoir engineers) can develop collaborative workflows and integrate operations to streamline processes. Such a framework may be considered an application and may be considered a data-driven application (e.g., where data is input for purposes of simulating a geologic environment).

[0038] In an example embodiment, the management components 110 may include features for geology and geological modeling to generate high-resolution geological models of reservoir structure and stratigraphy (e.g., classification and estimation, facies modeling, well correlation, surface imaging, structural and fault

analysis, well path design, data analysis, fracture modeling, workflow editing, uncertainty and optimization modeling, petrophysical modeling, etc.). Particular features may allow for performance of rapid 2D and 3D seismic interpretation, optionally for integration with geological and engineering tools (e.g., classification and estimation, well path design, seismic interpretation, seismic attribute analysis, seismic sampling, seismic volume rendering, geobody extraction, domain conversion, etc.). As to reservoir engineering, for a generated model, one or more features may allow for a simulation workflow to perform streamline simulation, reduce uncertainty and assist in future well planning (e.g., uncertainty analysis and optimization workflow, well path design, advanced gridding and upscaling, history match analysis, etc.). The management components 110 may include features for drilling workflows including well path design, drilling visualization, and real-time model updates (e.g., via real-time data links).

[0039] In an example embodiment, various aspects of the management components 110 may include add-ons or plug-ins (e.g., types of components) that operate according to specifications of a framework environment. For example, the framework environment marketed as the OCEAN® framework environment can allow for integration of add-ons (or plug-ins) into a PETREL® framework (e.g., for implementation in a workflow). The OCEAN® framework environment leverages .NET® tools (Microsoft Corporation, Redmond, Washington). In an example embodiment, various components may be implemented as add-ons (or plug-ins) that conform to and operate according to specifications of a framework environment (e.g., according to application programming interface (API) specifications, etc.).

[0040] Fig. 1 also shows an example of a framework 170 that includes a model simulation layer 180 along with a framework services layer 190, a framework core layer 195 and a modules layer 175. The framework 170 may include the commercially available OCEAN® framework where the model simulation layer 180 is the commercially available PETREL® seismic-to-simulation framework that can host OCEAN® framework applications.

[0041] The model simulation layer 180 may provide domain objects 182, act as a data source 184, provide for rendering 186 and provide for various user interfaces 188. Rendering 186 may provide a graphical environment in which applications can display their data while the user interfaces 188 may provide a

common look and feel for application user interface components (e.g., a user interface environment that aims to provide a relatively harmonious, comprehensible user experience).

[0042] In the example of Fig. 1, the domain objects 182 can include entity objects, property objects and optionally other objects. Entity objects may be used to geometrically represent wells, surfaces, reservoirs, etc., while property objects may be used to provide property values as well as data versions and display parameters. For example, an entity object may represent a well where a property object provides log information as well as version information and display information (e.g., to display the well as part of a model).

[0043] In the example of Fig. 1, data may be stored in one or more data sources (e.g., data stores), which may be at the same or different physical sites and accessible via one or more networks. The model simulation layer 180 may be configured to model projects. As such, a particular project may be stored where stored project information may include inputs, models, results and cases. Thus, upon completion of a modeling session, a user may store a project. At a later time, the project can be accessed and restored, for example, using the model simulation layer 180, which can recreate instances of the relevant domain objects.

[0044] In the example of Fig. 1, a search component 197 may be provided that allows for integration with a search engine (e.g., the STUDIO FIND™ search engine), one or more databases, one or more structuring components, one or more formatting components, etc. In an example embodiment, the search component 197 may be part of the framework 170 and provide for “plugging-in” to one or more other components (e.g., whether local or remote).

[0045] As an example, the search component 197 may receive data responsive to input from a pointing device (e.g., via a computer bus, network, wireless, etc. connection). In turn, the search component 197 may communicate the data in appropriate form to a database server (e.g., via a network, whether wired or wireless), optionally in a manner specified by one or more application programming interfaces (APIs) associated with the database server. In response, the search component 197 may receive information (e.g., via a network) from the database server (e.g., where the search component 197 makes an API call and the server responds to the call according to a specification for the API). The search component

197 may then process at least some of the information (e.g., structuring, formatting, etc.), which may be returned, for example, to process a workflow associated with the framework 170.

[0046] In the example of Fig. 1, the framework 170 may include or be operatively coupled to a search engine 198, which may be associated with the search component 197. As an example, the framework 170 may include or be operatively coupled to an analyzer 199, which may be optionally associated with the search component 197. As an example, the analyzer 199 may allow for selecting an item and analyzing that selected item with respect to other items. Such an approach may include accessing information associated with items via one or more of the search component 197, the search engine 198, etc.

[0047] In the example of Fig. 1, the geologic environment 150 may be outfitted with any of a variety of sensors, detectors, actuators, etc. For example, equipment 152 may include communication circuitry to receive and to transmit information with respect to one or more networks 155. Such information may include information associated with downhole equipment 154, which may be equipment to acquire information, to assist with resource recovery, etc. Other equipment 156 may be located remote from a well site and include sensing, detecting, emitting or other circuitry. Such equipment may include storage and communication circuitry to store and to communicate data, instructions, etc.

[0048] As an example, the system 100 may be used to perform one or more workflows. A workflow may be a process that includes a number of worksteps. A workstep may operate on data, for example, to create new data, to update existing data, etc. As an example, a workflow may operate on one or more inputs and create one or more results, for example, based on one or more algorithms. As an example, a system may include a workflow editor for creation, editing, executing, etc. of a workflow. In such an example, the workflow editor may provide for selection of one or more pre-defined worksteps, one or more customized worksteps, etc. As an example, a workflow may be a workflow implementable at least in part in the PETREL® software, for example, that operates on seismic data, seismic attribute(s), etc.

[0049] As an example, seismic data can be data acquired via a seismic survey where sources and receivers are positioned in a geologic environment to emit and

receive seismic energy where at least a portion of such energy can reflect off subsurface structures. As an example, a seismic data analysis framework or frameworks (e.g., consider the OMEGA® framework, marketed by Schlumberger Limited, Houston, Texas) may be utilized to determine depth, extent, properties, etc. of subsurface structures. As an example, seismic data analysis can include forward modeling and/or inversion, for example, to iteratively build a model of a subsurface region of a geologic environment. As an example, a seismic data analysis framework may be part of or operatively coupled to a seismic-to-simulation framework (e.g., the PETREL® framework, etc.).

[0050] As an example, a workflow may be a process implementable at least in part in the OCEAN® framework. As an example, a workflow may include one or more worksteps that access a module such as a plug-in (e.g., external executable code, etc.).

[0051] As an example, a framework may provide for modeling petroleum systems. For example, the commercially available modeling framework marketed as the PETROMOD® framework (Schlumberger Limited, Houston, Texas) includes features for input of various types of information (e.g., seismic, well, geological, etc.) to model evolution of a sedimentary basin. The PETROMOD® framework provides for petroleum systems modeling via input of various data such as seismic data, well data and other geological data, for example, to model evolution of a sedimentary basin. The PETROMOD® framework may predict if, and how, a reservoir has been charged with hydrocarbons, including, for example, the source and timing of hydrocarbon generation, migration routes, quantities, pore pressure and hydrocarbon type in the subsurface or at surface conditions. In combination with a framework such as the PETREL® framework, workflows may be constructed to provide basin-to-prospect scale exploration solutions. Data exchange between frameworks can facilitate construction of models, analysis of data (e.g., PETROMOD® framework data analyzed using PETREL® framework capabilities), and coupling of workflows.

[0052] As an example, a drillstring can include various tools that may make measurements. As an example, a wireline tool or another type of tool may be utilized to make measurements. As an example, a tool may be configured to acquire electrical borehole images. As an example, an imaging tool can acquire borehole

image data. A data acquisition sequence for such a tool can include running the tool into a borehole with acquisition pads closed, opening and pressing the pads against a wall of the borehole, delivering electrical current into the material defining the borehole while translating the tool in the borehole, and sensing current remotely, which is altered by interactions with the material.

[0053] Analysis of formation information may reveal features such as, for example, vugs, dissolution planes (e.g., dissolution along bedding planes), stress-related features, dip events, etc. As an example, a tool may acquire information that may help to characterize a reservoir, optionally a fractured reservoir where fractures may be natural and/or artificial (e.g., hydraulic fractures).

[0054] As an example, information acquired by a tool or tools may be analyzed using a framework such as the TECHLOG® framework (Schlumberger Limited, Houston, Texas). As an example, the TECHLOG® framework can be interoperable with one or more other frameworks such as, for example, the PETREL® framework, the OCEAN® framework, etc.

[0055] Fig. 2 shows an example of a system 200 that includes a computing system 211, a computing system 231, and a database 251 (e.g., including a server or servers) configured for communication via one or more networks 205. The computing system 211 provides for execution of a project framework 210 to present a GUI 212 and of a search component 214. Through interaction with the GUI 212, instructions and data may be transmitted by the search component 214 via the network 205 to the computing system 231, which provides for execution of a search engine 230, which may operate according to an index 235. In turn, the computing system 231 may transmit information to the computing system 211. As an example, the index 235 may pertain to items stored in the database 251 according to a file system, which may provide paths for items.

[0056] In the example of Fig. 2, items 252 may be rendered via the GUI 212 where the GUI 212 includes an analyzer option to access an analyzer 270 that can analyze at least one of the items 252 and optionally other items, for example, according to one or more characteristics 255. As an example, the analyzer 270 may output analytic results 280, which may be, for example, rendered via the GUI 212. In such an example, the analytic results 280 may be rendered for the one or more characteristics 255.

[0057] As an example, the analyzer 270 may access items 252 via the search component 214 or, for example, via one or more other components of the project framework 210 or, for example, via one or more other components that provide for access to items.

[0058] As an example, a user may enter search criteria and perform a search that returns items as search results. As shown in the example of Fig. 2, the analyzer 270 can provide an analysis for one or more of the items. For example, one of the items may be selected for an analysis with respect to one or more of the other items.

[0059] Fig. 3 shows an example of a method 300. The method 300 includes a reception block 310 for receiving a selected item, a reception block 320 for receiving one or more characteristics, an analysis block 330 for analyzing the selected item with respect to other items to generate analysis results, a render block 340 for rendering at least a portion of the analysis results to a display, a decision block 350 for deciding whether to compare items, a render block 360 for rendering results of a comparison, a decision block 370 for deciding whether to adjust one or more characteristics, and a continuation block 380 for continuing a workflow, etc.

[0060] As shown in the example of Fig. 3, the method 300 can include deciding not to compare items per the decision block 350 and deciding to adjust one or more characteristics per the decision block 370. In such an example, the method 300 may continue to the reception block 320 for receiving one or more adjusted characteristics. As an example, where a comparison is made, the method 300 may proceed to the render block 360 and then optionally to the continuation block 380 or the decision block 370.

[0061] The method 300 is shown in Fig. 3 in association with various computer-readable media (CRM) blocks 311, 321, 331, 341, 351, 361, 371 and 381. Such blocks generally include instructions suitable for execution by one or more processors (or cores) to instruct a computing device or system to perform one or more actions. While various blocks are shown, a single medium may be configured with instructions to allow for, at least in part, performance of various actions of the method 300. As an example, a CRM block can be a computer-readable storage medium that is non-transitory, not a carrier wave and not a signal.

[0062] As to an analysis, Fig. 3 shows various examples analyses 332, 334 and 336. As an example, an analysis may aim to allow for comparing relatively large

sets of information where various features of a framework may allow a user to assess analysis results, for example, to gain insight. As an example, the method 300 of Fig. 3 may optionally be implemented at a wellsite. For example, where a driller desires information about a well being drilled or to be drilled, the driller can access a well analytics framework via a computing device (e.g., mobile, desktop, etc.) and analyze wells. In such an example, the driller may compare wells to determine how to proceed with drilling a well at the wellsite. As an example, a well analytics framework may be implemented via a computing device in a driller's cabin at a wellsite where, for example, the computing device may be operatively coupled to a network or networks (e.g., for accessing information, etc.).

[0063] As an example, a method can include performing an analysis that can find analogs and/or outliers as to one or more types of items. For example, consider a method that includes finding wells: that have similar geological features; that have had similar interpretative procedures applied; that have had similar operational activities; and/or that have generated similar financial outcomes. Geological, interpretative, operative (e.g., operational) and financial (e.g., economic) are some examples of characteristics that may be associated with an item type such as a well. As an example, the method 300 of Fig. 3 may be a well analytics method that performs one or more analyses as to wells (e.g., information associated with wells, etc.).

[0064] As an example, a method can provide for comparing a plurality of characteristics in a manner that can improve insight. As an example, a method can include accessing data associated with a plurality of different domains. For example, a characteristic may be associated with a domain such as, for example, a geological domain concerning knowledge of geologists, an interpretative domain concerning knowledge of seismologists, an operative domain concerning knowledge of equipment operators (e.g., rig and wellsite equipment, etc.), a financial domain concerning knowledge of financial analysts, economists, etc. As an example, an analysis can include analyzing attributes across such types of domains, optionally in a vector-based manner, where items that are similar and items that are different may be identified. For example, consider an approach that can cluster wells as items that may be similar and that can indicate outlier wells as items that may be different.

[0065] As an example, a method can include finding analogs and/or outliers of items across various domains (e.g., geological, operative, interpretive, financial, etc.). Such a method may implement, for example, machine learning. As an example, such a method may implement clustering.

[0066] Cluster analysis or clustering can include the task of grouping a set of items in such a way that items in a group (e.g., a cluster) are more similar (in some sense or another) to each other than to those items in one or more other groups and/or than those items that may be disparate and deemed to be outliers. As an example, clustering can include statistical data analysis. As an example, clustering can be performed by one or more techniques such as, for example, one or more of machine learning, pattern recognition, image analysis, information retrieval, data compression, etc.

[0067] As an example, a method may implement one or more of connectivity models (e.g., hierarchical clustering that builds models based on distance connectivity); centroid models (e.g., consider a k-means algorithm that represents a cluster by a single mean vector); distribution models (e.g., clusters modeled using statistical distributions, such as multivariate normal distributions used by the Expectation-maximization algorithm); density models (e.g., defining clusters as connected dense regions in a data space); subspace models (e.g., clusters that are modeled with both cluster members and relevant attributes); group models (e.g., providing grouping information); graph-based models (e.g., a subset of nodes in a graph such that two nodes in the subset may be connected by an edge can be considered as a prototypical form of cluster, optionally with relaxations of a complete connectivity specification); etc.

[0068] As an example, a method may implement hard clustering where individual items belong to a cluster or not and/or soft clustering (e.g., consider fuzzy clustering, etc.) where individual items belong to individual clusters to a certain degree (e.g., consider a likelihood of belonging to a cluster).

[0069] As an example, clustering may be formulated as a multi-objective optimization problem. As an example, an appropriate clustering algorithm and associated parameter settings (e.g., including values such as the distance function to use, a density threshold or the number of expected clusters) can depend on an individual dataset or individual datasets and, for example, an intended use or uses of

results. As an example, cluster analysis may be performed iteratively. As an example, cluster analysis may be performed interactively. As an example, an analysis can include modifying data (e.g., preprocessing, etc.) and, for example, adjusting one or more model parameters (e.g., cluster or other model parameters) to achieve desired analysis results.

[0070] In the example of Fig. 3, the analysis 332 can be a cluster analysis that aims to cluster items, optionally with outlier identification. As an example, where items are wells, such items may be associated with numerous features on different facets or characteristics (e.g., consider one or more of geological, interpretative, operative and financial). As an example, a clustering algorithm may be applied to group wells on features in certain facets (e.g., characteristics). As an example, a clustering algorithm may cluster wells based on geographic location and drilling interval leads to groups including wells similar in operative characteristic attributes. As an example, clustering may be applied across multiple characteristics, for example, grouping similar items (e.g., wells, etc.) in operative and geological characteristics.

[0071] As an example, an analysis or analyses may cluster and compare item characteristics where the characteristics can include, for example, one or more of geological, interpretation method (e.g., interpretative), engineering, operative (e.g., operational), and financial (e.g., economic, production-based, other outcome, etc.).

[0072] In the example of Fig. 3, the analyses 334 and 336 pertain to several data tables from the Smith Bits drilling dataset (Smith Bits, a company of Schlumberger Limited, Houston, Texas) and clustering of wells experimentally. In the analysis 334, a plot is shown as to well location and well drilling interval while in the analysis 336, a plot is shown as to well project year and well drilling interval. As to drilling interval, such an attribute can be selected based on one or more factors. For example, a drilling interval may be selected to be of a distance that aims to reduce trips, that accounts for bit performance, durability, etc., that accounts for rate of penetration (ROP), etc.

[0073] As an example, a method may commence via selecting an item such as, for example, a well. In such an example, the item may be an item rendered to a graphical user interface, for example, in a 2D and/or a 3D representation of a geologic environment (e.g., consider a rendering in PETREL® framework, the

TECHOLOG® framework, etc.). As an example, an item may be an item in a list of search results. For example, consider the STUDIO FIND® search framework being implemented to search one or more data stores and return search results that include one or more selectable items that can be analyzed with respect to other items. As an example, a computing device can include one or more input mechanisms that can be utilized to select an item for an analysis. For example, consider a mouse, a touchscreen, a virtual reality system (e.g., HOLOLENS® VR system, Microsoft Corporation, Redmond, Washington), etc.

[0074] Fig. 4 shows an example of a graphical user interface (GUI) 400 for a project in a project framework (e.g., the PETREL® framework). In the GUI 400 of Fig. 4, selectable search criteria 410 are presented in a tree hierarchy. For example, under a criterion level “Seismic Survey” there is another criterion level “Input”, which may, for example, be organized by yet another criterion level “number” (e.g., year). In the example of Fig. 4, the GUI 400 includes an E&P canvas 420 (e.g., a panel or window), one or more search results 430 in the canvas 420 and a table view of search results 440. As an example, the GUI 400 of Fig. 4 may be implemented in an E&P application with a search filter module, a search results module and a 3D visualization canvas module. As shown in Fig. 4, selection of well “W3_2” in the search results shows the model data for the well “W3_2” in the canvas 430.

[0075] In the example of Fig. 4, the GUI 400 includes a menu 440 that includes various menu options such as, for example, “select all”, “toggle off”, “find similar” and “other”. As an example, the “find similar” option may be selected via an input mechanism (e.g., mouse, touch-screen, voice command, etc.). In such an example, a computing device may receive a command to actuate an analyzer that can perform an analysis for a selected item. For example, consider an analysis for the well “W3_2”, as a selected item.

[0076] Fig. 5 shows an example of a display 501 where an example of a GUI 510 is rendered to the display 501. As shown in Fig. 5, the GUI 510 can include an analog item finder tab 512, a selected item field 514, a similar items control 516, selectable characteristic controls 518, a load control 520, color or other coding 530, a results pane 540 and various other controls such as, for example, the controls 590. In the example of Fig. 5, the controls 590 can include one or more of a select all control, an unselect all control, a compare control, a load to STUDIO™ control, etc.

[0077] In the example of Fig. 5, the results pane 540 shows results for items that are other wells where the results are organized by the characteristics geological interpretative, operative and financial. In the example of Fig. 5, the ordering of the items is based on similarity where the uppermost item (e.g., well W0_2) is the most similar to the selected item (e.g., well W3_2). Such an analysis can be based on attributes for the items as associated with the characteristics.

[0078] In the example of Fig. 5, the pane 540 can include bars such as in a bar chart. As an example, color coding may be applied to bars where a color may be a color along a spectrum from low to high. For example, red may indicate similarity and may correspond to a longer bar length than blue, which may indicate dissimilarity (e.g., a lack of similarity) and may correspond to a shorter bar length. In the example of Fig. 5, the color coding 530 includes most similar on the left with a cross-hatching fill and least similar on the right with a solid black fill. Intermediate colors may include, for example, orange, yellow and green, such that a spectrum ranges from red (highest similarity), to orange, to yellow, to green to blue (lowest similarity).

[0079] In the example of Fig. 5, the highest ranking item is similar as to geological, interpretative and financial characteristics but less similar as to its operative characteristic. As an example, a highlighting feature may be implemented where a graphic such as the box "Different Operative" is automatically generated and rendered to the display 501.

[0080] As an example, the GUI 510 may be utilized to make a comparison between the selected item and one or more of the other items. For example, a check box may be selected for a comparison of the item W0_2 to the item W3_2. In such an example, the compare control may be actuated to commence a comparison. For example, consider the decision block 350 of Fig. 3 where a decision can be made to perform a comparison (e.g., responsive to receipt of a command, etc. via an input mechanism).

[0081] Fig. 6 shows an example of a display 601 and an example of a GUI 610 rendered to the display 601. As shown, the GUI 610 includes a tab 612 that indicates that the GUI 610 pertains to a comparison of items. For example, the GUI 610 may be automatically generated and rendered in response to actuation of a compare control (see, e.g., the controls 590 of the GUI 510 of Fig. 5).

[0082] In the example of Fig. 6, the GUI 610 includes a table 614 with a tabular listing of attribute values for the characteristics as associated with the items being compared. Specifically, the GUI 610 shows information associated with a comparison of the item W3_2 and the item W0_2, which corresponds to the highest ranked item in the pane 540 of the GUI 510 per an analysis of items with respect to the item W3_2. Thus, the information in the GUI 610 may allow a user to understand more particularly differences and/or similarities that exist between the selected items.

[0083] In the example of Fig. 6, a comparison type control 616 may be included that allows for selection of a type of comparison. For example, in Fig. 6, the GUI 610 includes a spider graph 618 as a type of comparison where corners of the spider graph correspond to characteristics. In such a manner, a user may view the spider graph 618 and see that the operative score or operative value of the item W0_2 differs substantially from that of the item W3_2. A user may also view the table 614 to determine how data may differ as to particular operative attributes. For example, the project year is shown to differ by about 25 years, the drilling interval is shown to differ by about 13 and the bit size is shown to differ by about 9. Such attributes may be components of an operative score or operative value that can quantify differences and/or similarities. As an example, one or more portions of the GUI 610 may be highlighted to indicate where differences and/or similarities exist. As an example, highlighting can include color and/or other type of coding that may allow a user to more readily distinguish information for the compared items.

[0084] In the example of Fig. 6, the GUI 610 also shows attribute values in the table 614 for the other characteristics. Such attribute values may include, for example, geological attributes such as formation time, formation type and interval, interpretative attributes such as frequency, vibration and area size and economic attributes such as budget, production rate and profit.

[0085] Fig. 7 shows an example of a display 701 and an example of a GUI 710 rendered to the display 701. In the example of Fig. 7, the highest ranking item is lacking information as to its operative characteristic and, for example, lacking information as to its financial characteristic.

[0086] Fig. 8 shows example data 800 as including example data 810 from a geological and interpretive dataset, example data 820 from a financial dataset, and example data 830 from an operative dataset. As shown in Fig. 8, datasets may differ

based on characteristic. For example, characteristics may correspond to data sources and/or data stores, which may be handled by different entities, different systems, etc. In such an example, the organization and/or handling of data may result in one or more differences. As an example, such differences in data may confound a system that relies on exact matching of information.

[0087] As an example, a difference may exist in a category and/or in a value. For example, the data 810 shows an attribute category "Well_ID" while the data 820 shows an attribute category "ID_Well". Further, the data 830 shows a Well_ID attribute value of Well02_NS; whereas, the data 810 and 820 show attribute values Well_02_NS. In such examples, matching may not occur across the different datasets, which may be in the same data store or in different data stores, for example, distributed in a cloud platform, etc. Fig. 8 also shows an attribute value as to operator that differs (e.g., Entity XYZ versus XOM) and an attribute value as to a numeric value that differs due to a sign (e.g., -90.065918 versus 90.065918). Such differences may confound an exact match algorithm that seeks out information on items and/or may confound an algorithm that determines characteristic values (e.g., characteristic scores).

[0088] Fig. 9 shows an example of a display 901 and an example of a GUI 910 that is rendered to the display 901. In the example of Fig. 9, the GUI 910 includes a results pane 940 and an intelligent matching control 950. In such an example, the intelligent matching control 950 may be actuated, enabled, etc. (e.g., via a check box, etc.).

[0089] As an example, an intelligent matching control may allow for adjusting a resolution of a search and/or adjusting one or more attribute values. For example, as to searching approximate string matching may be implemented. As an example, approximate string matching (e.g., consider fuzzy string searching, etc.) may allow for finding strings that match a pattern approximately (e.g., rather than an exact match).

[0090] As an example, a resolution algorithm may aim to identify and link different manifestation of an item, whether via one or more categories and/or via data (e.g., value or values) associated with one or more categories.

[0091] As an example, a resolution algorithm may include editing a distance, set similarity, phonetic similarity, translation-based similarity. As an example, a

resolution algorithm may include one or more of machine learning, supervised learning, active learning, correlation clustering, collective relational clustering, probabilistic technique, Markov logic, probabilistic soft logic, etc.

[0092] As an example, a framework such as, for example, the Alchemy framework (University of Washington, Seattle, Washington) may be utilized for one or more purposes (e.g., analysis, resolution, etc.). The Alchemy framework provides algorithms for statistical relational learning and probabilistic logic inference, based on the Markov logic representation. Applications of the Alchemy framework can include, for example, one or more of collective classification, link prediction, entity resolution, social network modeling, and information extraction.

[0093] As an example, a framework such as, for example, the SERF framework (Stanford University, Palo Alto, California) may be utilized for one or more purposes (e.g., analysis, resolution, etc.). The SERF framework can include the R-Swoosh algorithm that can takes as input a dataset of records (e.g., in XML, etc.) and a “MatcherMerger” class that implements functions to match and merge pairs of records, and return a dataset of resolved records.

[0094] As an example, the OYSTER framework (University of Arkansas, Little Rock, Arkansas) may be utilized, for example, for entity resolution, etc. The OYSTER (Open sYSTem Entity Resolution) framework supports probabilistic direct matching, transitive linking, and asserted linking. To facilitate prospecting for match candidates (blocking), the framework can build and maintain an in-memory index of attribute values to identities. As another example, the D-Dupe framework (University of Maryland Institute for Advanced Computer Studies, College Park, Maryland) may be utilized for analysis, resolution, etc.

[0095] In the example of Fig. 9, the pane 940 includes bars along with confidence information. For example, the value 98% can indicate a high confidence as to a result from an approximate string matching algorithm.

[0096] As shown in the example of Fig. 9, the intelligent matching may handle issues such as those described with respect to the example data 800 of Fig. 8. As an example, intelligent matching may act to fill-in portions of comparison results where data may otherwise be lacking when, for example, an exact match approach is implemented.

[0097] As an example, intelligent matching may operate according to rules. For example, where certain types of attribute category mismatches may be known to exist across data stores, a rule may act to counter such mismatches. As an example, intelligent matching may operate according to rules that are specific to characteristics. For example, a financial characteristic data store may be searched using intelligent matching that accounts for known differences with respect to a geological characteristic data store.

[0098] As an example, intelligent matching may include a data adjustment feature that can adjust one or more data values such as, for example, a sign convention (e.g., for longitude, etc.). As an example, a data adjustment feature may act to insert and/or delete one or more characters, for example, on a temporary basis for purposes of analysis, comparison, etc.

[0099] Fig. 10 shows an example of a display 1001 and an example of a GUI 1010 that is rendered to the display 1001. In the example of Fig. 10, the GUI 1010 includes a tab 1012 that indicates that the GUI 1010 pertains to matching details.

[00100] The GUI 1010 may be rendered in response to, for example, actuation of a control associated with an intelligent matching algorithm. For example, the matching details illustrated in the GUI 1010 may include information that has been processed via an intelligent matching algorithm where, for example, a confidence level may be associated with approximate matching.

[00101] In the example of Fig. 10, the operative data set column includes attribute categories Well_ID, Operator, Longitude and Latitude and corresponding attribute values Well02_NS, XOM, 25.304304 and -90.065918. In the example of Fig. 10, the values Well02_NS and XOM are highlighted to indicate that they are not exactly matching values of one or more other datasets, particularly the geological dataset and the interpretative dataset.

[00102] As an example, the GUI 1010 of Fig. 10 may include a control to load more candidates 1070 (e.g., more candidate items). For example, one or more other possible matching candidates may be access and rendered.

[00103] Fig. 11 shows an example of a display 1101 and an example of a GUI 1110 that is rendered to the display 1101. In the example of Fig. 11, the GUI 1110 includes a tab 1112 that indicates that information as to matching candidates is rendered. For example, the GUI 1110 may render a table 1172 that includes

information organized by an item ID category (e.g., Well_ID, etc.). In such an example, attribute values may be rendered and, for example, confidence information. As shown, confidence information may be based at least in part on a plurality of attribute values. For example, the entity attribute value, the latitude attribute value and/or the longitude attribute value may be utilized to determine a degree of match (e.g., a confidence level).

[00104] In the example of Fig. 11, a map 1174 may be rendered that shows locations of items, for example, according to corresponding latitude and longitude values (e.g., attribute values). While the locations are illustrated via filled circles, such indicators may be color coded based at least in part on confidence. As an example, the indicators may be selectable via an input mechanism (e.g., a stylus, a mouse, a touchscreen, etc.). In such an example, information for a selected candidate item or candidate items may be rendered, for example, in the table 1172.

[00105] In the example of Fig. 11, the GUI 1110 can include a load to match control 1192. For example, where a user identifies one or more suitable candidates, information associated with such one or more candidates may be loaded to match. In such an example, the information may populate a results pane such as, for example, the results pane 940 of the GUI 910 of Fig. 9.

[00106] As an example, a user may implement one or more of an automatic match component and a manual match component. For example, where an automatic match component executes an approximate string matching algorithm and where results thereof are deemed less than desirable, a user may implement a manual approach. As an example, in the GUI 1110 of Fig. 11, the map 1174 may be part of a manual component that can allow for selecting one or more locations via the map 1174. In such a manner, a user may visually assess values and determine whether a load to match is appropriate. As an example, a user may find automated match results acceptable and, optionally, utilize a manual match.

[00107] Fig. 12 shows an example of a method 1210 that includes a reception block 1212 for receiving a selected item and selected characteristics; an analysis block 1214 for analyzing other items with respect to the selected item and the selected characteristics to generate analysis results; and a render block 1216 for rendering a graphical user interface to a display where the graphical user interface includes, for example, at least a portion of the analysis results organized with respect

to the selected item and at least a portion of the other items and at least one of the characteristics. In such an example, the graphical user interface can include a comparison control actuatable to perform a comparison between at least two of the items.

[00108] The method 1210 is shown in Fig. 12 in association with various computer-readable media (CRM) blocks 1213, 1215 and 1217. Such blocks generally include instructions suitable for execution by one or more processors (or cores) to instruct a computing device or system to perform one or more actions. While various blocks are shown, a single medium may be configured with instructions to allow for, at least in part, performance of various actions of the method 1210. As an example, a CRM block can be a computer-readable storage medium that is non-transitory, not a carrier wave and not a signal.

[00109] Fig. 12 also shows an example of a system 1220 that includes a user block 1221 that can generate one or more graphical user interfaces that can be rendered to one or more displays operatively coupled to one or more computing devices, computing systems, etc. In such an example, the GUIs may be in part browser application executable. For example, instructions for generation of such GUIs and/or operation of such GUIs can include script (e.g., JAVASCRIPT® language, SunMicrosystem, Santa Clara, California; the JAVASCRIPT® language is a high-level, dynamic, untyped, and interpreted programming language). As an example, the user block 1221 can include instructions and/or information in HTML (hyper-text mark-up language) and/or in CSS (cascading style sheets), which is a style sheet language used for describing the presentation of a document (e.g., a GUI, a webpage, etc.) written in a markup language.

[00110] As an example, an application may be a web application that may be implemented in a client-server architecture. For example, a client device can be a computing device that includes a browser application that can execute instructions (e.g., interpret, execute, etc.) that can provide for rendering information to a display (e.g., via display circuitry, which may include one or more GPUs, etc.) and, for example, for interactions with rendered information such as, for example, one or more graphical controls of a GUI.

[00111] In the example of Fig. 12, the system 1220 can include a search block 1280 that may be operatively coupled to a search engine 1260 that can receive

information 1262, parse information 1264, match information 1266 and transmit information 1268. In such an example, the search engine 1260 may optionally operate according to one or more matching or resolution algorithms (e.g., approximate string matching, etc.). As shown in the example of Fig. 12, the system 1220 can include one or more databases 1260 (e.g., data stores, data sources, etc.) where information may be indexed and stored, for example, in an index database 1270, which is operatively coupled to the search engine 1260.

[00112] In the example of Fig. 12, the system 1220 can include a results block 1285 and an analysis block 1290. For example, the results block 1285 can include results that may be search results from the search block 1280 as may be provided, for example, via the search engine 1260. As indicated, the results block 1285 can be operatively coupled to the user block 1221 and the user block 1221 can be operatively coupled to the search block 1280 and, for example, the analysis block 1290. In such an example, the user block 1221 can access functionalities of the search block 1280, the results block 1285 and the analysis block 1290.

[00113] As an example, the system 1220 may be utilized to implement a method such as, for example, the method 1210 of Fig. 12. For example, the user block 1221 may be utilized to render a GUI that can allow for receipt of a selected item and selected characteristics where, as an example, the selected item may be a search result item of the results block 1285. As an example, the analysis block 1290 of the system 1220 may be triggered via the user block 1221 to perform the analysis of the analysis block 1214 of the method 1210. As an example, the user block 1221 may be utilized to perform the rendering of the render block 1216 of the method 1210. As an example, the CRM blocks 1213, 1215 and 1217 may be components of the system 1220.

[00114] As an example, the system 1220 may include a well analytics framework. For example, the analysis block 1290 may be a well analytics framework that can provide for analysis of well information associated with a plurality of wells. In such an example, the wells may be in a region or regions. In such an example, information associated with the wells may be stored in one or more data stores. As an example, information associated with wells may be stored in one or more data stores based at least in part on one or more characteristics (e.g., geological, interpretative, operative, financial, etc.). As an example, a first data store may be

associated with a first entity and a second data store may be associated with a second entity where the entities may differ and/or where the data storage frameworks differ. For example, one entity may utilize a data storage framework from a first vendor and another entity may utilize a data storage framework from a second vendor. In such an example, some differences may exist as to how data is organized, structured, accessed, etc. As an example, a well analytics framework may be operatively coupled to one or more search engines such that data can be searched in one or more data stores. As an example, a well analytics framework may implement one or more matching algorithms which may optionally account for one or more differences in data stores, which may, for example, pertain to domains that may correspond to characteristics.

[00115] As an example, a method can include implementing one or more machine learning approaches for finding analogs and outliers across geologic, operational, interpretive and financial characteristics. As an example, an analytics component (e.g., an analyzer, etc.) can be implemented to provide usable insights to users. For example, an analytics component may be implemented in an exploration and production environment for hydrocarbons. As an example, an analytics component may allow a user to quickly compare large sets of information and allow the user assess, at one or more levels of detail, the information (e.g., to gain insights, etc.). As an example, an analytics component may be configured to analyze data for various wells. For example, such a component may find wells with similar geological characteristics (e.g., optionally in part via one or more search engines, etc.). As an example, a component can provide for finding wells with matching operational activities or matching financial benefits. As an example, an analytics component may be operatively coupled to and/or a part of a search framework (e.g., consider the STUDIO FIND™ search framework, etc.).

[00116] As an example, a GUI may allow a user to right-click or otherwise select one or more available actions associated with a well and initiate an analysis. The right-click may, for example, display a menu with an option such as “find similar” to begin looking for analogs. As an example, a GUI can include a menu for selecting facets for comparison (e.g., characteristics for comparison). For example, a user may select one or more facets that can be used to find analogous wells. As an example, a user can select a target well and request a well-to-well comparison with

one or more other wells. As an example, a user can select a set of wells and compare how similar they are to each other.

[00117] As an example, a well (e.g., Well_02_NS) may be identified as being approached differently from an operational perspective, yet yielding substantially similar results as a selected well (e.g., a target well). Based on such information, a user may evaluate which of the operational approaches is most cost effective (e.g., less expensive) and proceed with some surety that the change in operational approach will not negatively impact the yield.

[00118] As an example, a user can specify similarities and differences of relevance. For example, a user may search for wells with similar geological, interpretative, and financial properties but different operative properties. Such an approach may allow the user to see the different operative factors that can be used without negatively affecting the financials. In such an example, a well analytics framework may provide a user with an ability to gain insight into how to approach a new well with similar geological and interpretive properties without negatively impacting the yield of the new well.

[00119] As an example, a method can include receiving a selected item and selected characteristics; analyzing other items with respect to the selected item and the selected characteristics to generate analysis results; and rendering a graphical user interface to a display that includes at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics where the graphical user interface includes a comparison control actuable to perform a comparison between at least two of the items. In such an example, the at least two of the items can include the selected and at least one of the other items. As an example, a method can include performing well analytics, for example, where items include wells, an analysis may be performed for wells.

[00120] As an example, a method can include, responsive to actuation of a comparison control, performing a comparison. In such an example, performing the comparison can include rendering a graphical user interface to a display that includes a table. As an example, performing a comparison can include rendering a graphical user interface to a display that includes a plot. As an example, consider a

spider plot where vertices of the spider plot correspond to at least a portion of selected characteristics.

[00121] As an example, a method can include performing data resolution to identify at least a portion of other items (e.g., with respect to a selected item or selected items). In such an example, the method can include rendering confidence information to a graphical user interface for at least a portion of the identified items.

[00122] As an example, a method can include clustering as a type of analyzing. For example, a method can include receiving a selected item and selected characteristics and analyzing other items with respect to the selected item and the selected characteristics at least in part via clustering to generate analysis results. In such an example, the method may include rendering a graphical user interface to a display that includes at least a portion of the analysis results.

[00123] As an example, at least a portion of analysis results organized with respect to a selected item and at least a portion of other items and at least one selected characteristic can be organized as a bar chart array. In such an example, the bar chart array may include color coding. As an example, the pane 540 of the GUI 510 of Fig. 5 includes a bar chart array where the array is defined in part by items as rows and characteristics as columns. As mentioned, bars may be color coded or otherwise coded.

[00124] As an example, a method can include rendering a GUI to a display where the GUI includes a map that indicates locations associated with candidate items, at least a portion of which may be identifiable as additional other items. For example, the GUI 1110 of Fig. 11 shows the map 1174, which may include locations of candidate items where an item may be selectable to consider that items as a possible matching item (e.g., as to one or more criteria) and to be considered as an other item (e.g., or additional other item) for an analysis, etc.

[00125] As an example, items can be and/or include items associated with a model of a geologic environment. For example, consider items associated with a model of a seismic-to-simulation framework (e.g., consider the PETREL® framework). As an example, items may be associated with a log information framework (e.g., consider the TECHLOG® framework). As an example, items can be and/or include wells. For example, an item may be a representation of a physical entity in a geologic environment such as, for example, a well, a feature of a geologic

environment (e.g., a bore hole, a formation, a salt dome, a fracture, a horizon, a reservoir, etc.).

[00126] As an example, selected characteristics can include at least one characteristic selected from a group of geological, interpretative, operative and financial characteristics. As an example, a group may include one or more other types of characteristics.

[00127] As an example, a selected item may be a search result item. For example, where a search is performed that returns search results, an item may be selectable (e.g., via a graphical user interface, etc.) where the selected item may be analyzed with respect to other items, for example, based at least in part on one or more characteristics. In such an example, the characteristics may include attributes and the attributes may include attribute values. As an example, an analysis can include computing a characteristic score or value (e.g., a characteristic metric, etc.) based at least in part on attribute values, which may be, for example, numeric values, character strings, alphanumeric, etc.

[00128] As an example, a system can include one or more processors; memory operatively coupled to at least one of the one or more processors; and instructions stored in the memory and executable by at least one of the one or more processors to instruct the system to receive a selected item and selected characteristics, analyze other items with respect to the selected item and the selected characteristics to generate analysis results, and render a graphical user interface to a display that includes at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics where, for example, the graphical user interface includes a comparison control actuatable to perform a comparison between at least two of the items. In such an example, the items can be and/or include items associated with a model of a geologic environment. As an example, a system can be and/or include a well analytics framework.

[00129] As an example, one or more computer-readable storage media can include computer-executable instructions executable to instruct a computing device to: receive a selected item and selected characteristics; analyze other items with respect to the selected item and the selected characteristics to generate analysis results; and render a graphical user interface to a display that includes at least a

portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics where, for example, the graphical user interface can include a comparison control actuatable to perform a comparison between at least two of the items. In such an example, the items can be and/or include items associated with a model of a geologic environment.

[00130] As an example, one or more computer-readable storage media can include computer-executable instructions executable to instruct a computing device to perform: receiving a selected item and selected characteristics; analyzing other items with respect to the selected item and the selected characteristics to generate analysis results; and rendering a graphical user interface to a display that includes at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics where, for example, the graphical user interface can include a comparison control actuatable to perform a comparison between at least two of the items.

[00131] As an example, a method can include receiving a selection of a first object (e.g., an item); receiving a selection of one or more second objects (e.g., items); and, for example, finding similarities and/or dissimilarities between the first object and the one or more second objects. As an example, a non-transitory computer-readable medium storing instructions can, when executed by a processor, cause the processor to perform operations, where the operations include, for example, applying machine learning to identify one or more wells that are analogs of a target well.

[00132] Fig. 13 shows components of an example of a computing system 1300 and an example of a networked system 1310. The system 1300 includes one or more processors 1302, memory and/or storage components 1304, one or more input and/or output devices 1306 and a bus 1308. In an example embodiment, instructions may be stored in one or more computer-readable media (e.g., memory/storage components 1304). Such instructions may be read by one or more processors (e.g., the processor(s) 1302) via a communication bus (e.g., the bus 1308), which may be wired or wireless. The one or more processors may execute such instructions to implement (wholly or in part) one or more modules, components, etc. (e.g., as part of a method). A user may view output from and interact with a

process via an I/O device (e.g., the device 1306). In an example embodiment, a computer-readable medium may be a storage component such as a physical memory storage device, for example, a chip, a chip on a package, a memory card, etc.

[00133] In an example embodiment, components may be distributed, such as in the network system 1310. The network system 1310 includes components 1322-1, 1322-2, 1322-3, . . . 1322-N. For example, the components 1322-1 may include the processor(s) 1302 while the component(s) 1322-3 may include memory accessible by the processor(s) 1302. Further, the component(s) 1322-2 may include an I/O device for display and optionally interaction with a method. The network may be or include the Internet, an intranet, a cellular network, a satellite network, etc.

[00134] As an example, a device may be a mobile device that includes one or more network interfaces for communication of information. For example, a mobile device may include a wireless network interface (e.g., operable via IEEE 802.11, ETSI GSM, BLUETOOTH®, satellite, etc.). As an example, a mobile device may include components such as a main processor, memory, a display, display graphics circuitry (e.g., optionally including touch and gesture circuitry), a SIM slot, audio/video circuitry, motion processing circuitry (e.g., accelerometer, gyroscope), wireless LAN circuitry, smart card circuitry, transmitter circuitry, GPS circuitry, and a battery. As an example, a mobile device may be configured as a cell phone, a tablet, etc. As an example, a method may be implemented (e.g., wholly or in part) using a mobile device. As an example, a system may include one or more mobile devices.

[00135] As an example, a system may be a distributed environment, for example, a so-called “cloud” environment where various devices, components, etc. interact for purposes of data storage, communications, computing, etc. As an example, a device or a system may include one or more components for communication of information via one or more of the Internet (e.g., where communication occurs via one or more Internet protocols), a cellular network, a satellite network, etc. As an example, a method may be implemented in a distributed environment (e.g., wholly or in part as a cloud-based service). As an example, a cloud platform such as, for example, the AZURE® cloud platform may be utilized (Microsoft Corporation, Redmond, Washington).

[00136] As an example, information may be input from a display (e.g., consider a touchscreen), output to a display or both. As an example, information may be output to a projector, a laser device, a printer, etc. such that the information may be viewed. As an example, information may be output stereographically or holographically. As to a printer, consider a 2D or a 3D printer. As an example, a 3D printer may include one or more substances that can be output to construct a 3D object. For example, data may be provided to a 3D printer to construct a 3D representation of a subterranean formation. As an example, layers may be constructed in 3D (e.g., horizons, etc.), geobodies constructed in 3D, etc. As an example, holes, fractures, etc., may be constructed in 3D (e.g., as positive structures, as negative structures, etc.).

[00137] Although only a few example embodiments have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments. Accordingly, all such modifications are intended to be included within the scope of this disclosure as defined in the following claims. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents, but also equivalent structures. Thus, although a nail and a screw may not be structural equivalents in that a nail employs a cylindrical surface to secure wooden parts together, whereas a screw employs a helical surface, in the environment of fastening wooden parts, a nail and a screw may be equivalent structures. It is the express intention of the applicant not to invoke 35 U.S.C. § 112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words “means for” together with an associated function.

CLAIMS

What is claimed is:

1. A method comprising:
receiving a selected item and selected characteristics;
analyzing other items with respect to the selected item and the selected characteristics to generate analysis results; and
rendering a graphical user interface to a display that comprises at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics wherein the graphical user interface comprises a comparison control actuatable to perform a comparison between at least two of the items.
2. The method of claim 1 wherein the at least two of the items comprise the selected and at least one of the other items.
3. The method of claim 1 comprising, responsive to actuation of the comparison control, performing the comparison.
4. The method of claim 3 wherein the performing the comparison comprises rendering a graphical user interface to the display that comprises a table.
5. The method of claim 3 wherein the performing the comparison comprises rendering a graphical user interface to the display that comprises a plot.
6. The method of claim 3 wherein the performing the comparison comprises rendering a graphical user interface to the display that comprises a spider plot wherein vertices of the spider plot correspond to at least a portion of the selected characteristics.
7. The method of claim 1 comprising performing data resolution to identify at least a portion of the other items.

8. The method of claim 7 comprising rendering confidence information to the graphical user interface for at least a portion of the identified items.
9. The method of claim 1 wherein the analyzing comprises clustering.
10. The method of claim 1 wherein the at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics comprises a bar chart array.
11. The method of claim 10 wherein the bar chart array comprises color coding.
12. The method of claim 1 comprising rendering a graphical user interface to the display that comprises a map that indicates locations associated with candidate items, at least a portion of which are identifiable as additional other items.
13. The method of claim 1 wherein the items comprise items associated with a model of a geologic environment.
14. The method of claim 1 wherein the items comprise wells.
15. The method of claim 1 wherein the selected characteristics comprise at least one characteristic selected from a group consisting of geological, interpretative, operative and financial characteristics.
16. The method of claim 1 wherein the selected item comprises a search result item.
17. A system comprising:
 - one or more processors;
 - memory operatively coupled to at least one of the one or more processors;
 - and

instructions stored in the memory and executable by at least one of the one or more processors to instruct the system to

receive a selected item and selected characteristics,

analyze other items with respect to the selected item and the selected characteristics to generate analysis results, and

render a graphical user interface to a display that comprises at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics wherein the graphical user interface comprises a comparison control actuable to perform a comparison between at least two of the items.

18. The system of claim 17 wherein the items comprise items associated with a model of a geologic environment.

19. One or more computer-readable storage media comprising computer-executable instructions executable to instruct a computing device to:

receive a selected item and selected characteristics;

analyze other items with respect to the selected item and the selected characteristics to generate analysis results; and

render a graphical user interface to a display that comprises at least a portion of the analysis results organized with respect to the selected item and at least a portion of the other items and at least one of the characteristics wherein the graphical user interface comprises a comparison control actuable to perform a comparison between at least two of the items.

20. The one or more computer-readable media of claim 19 wherein the items comprise items associated with a model of a geologic environment.

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System 100

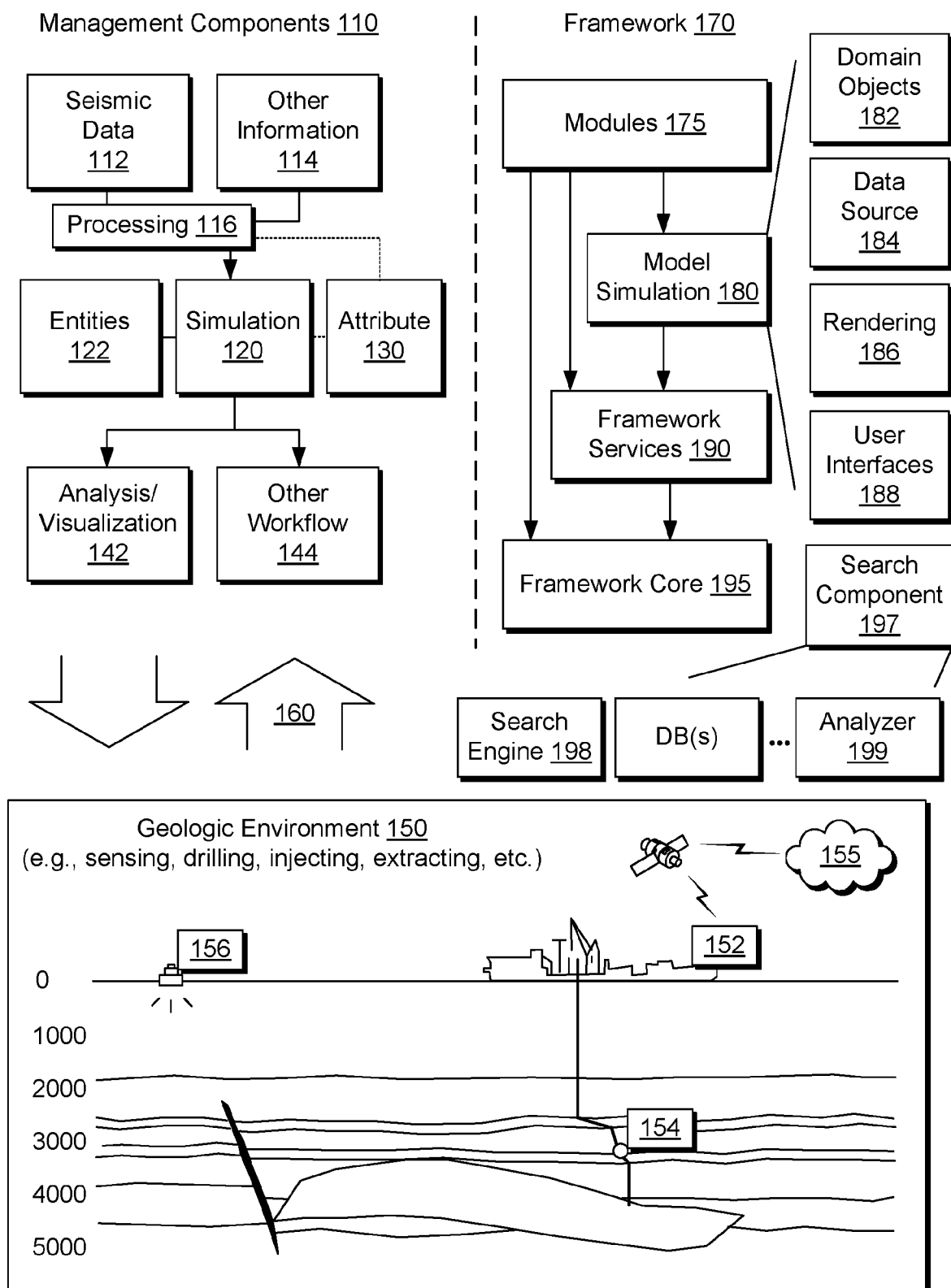


Fig. 1

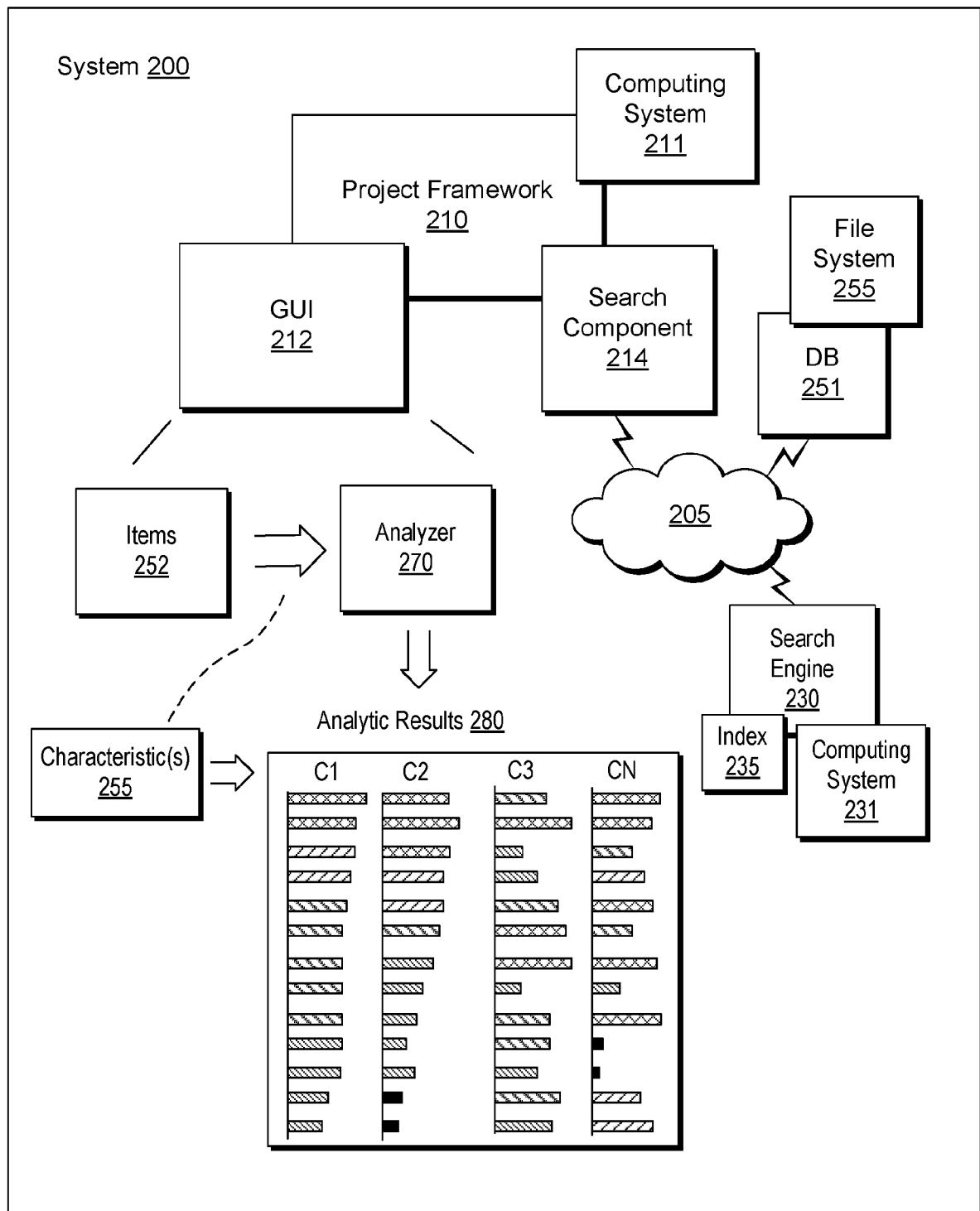


Fig. 2

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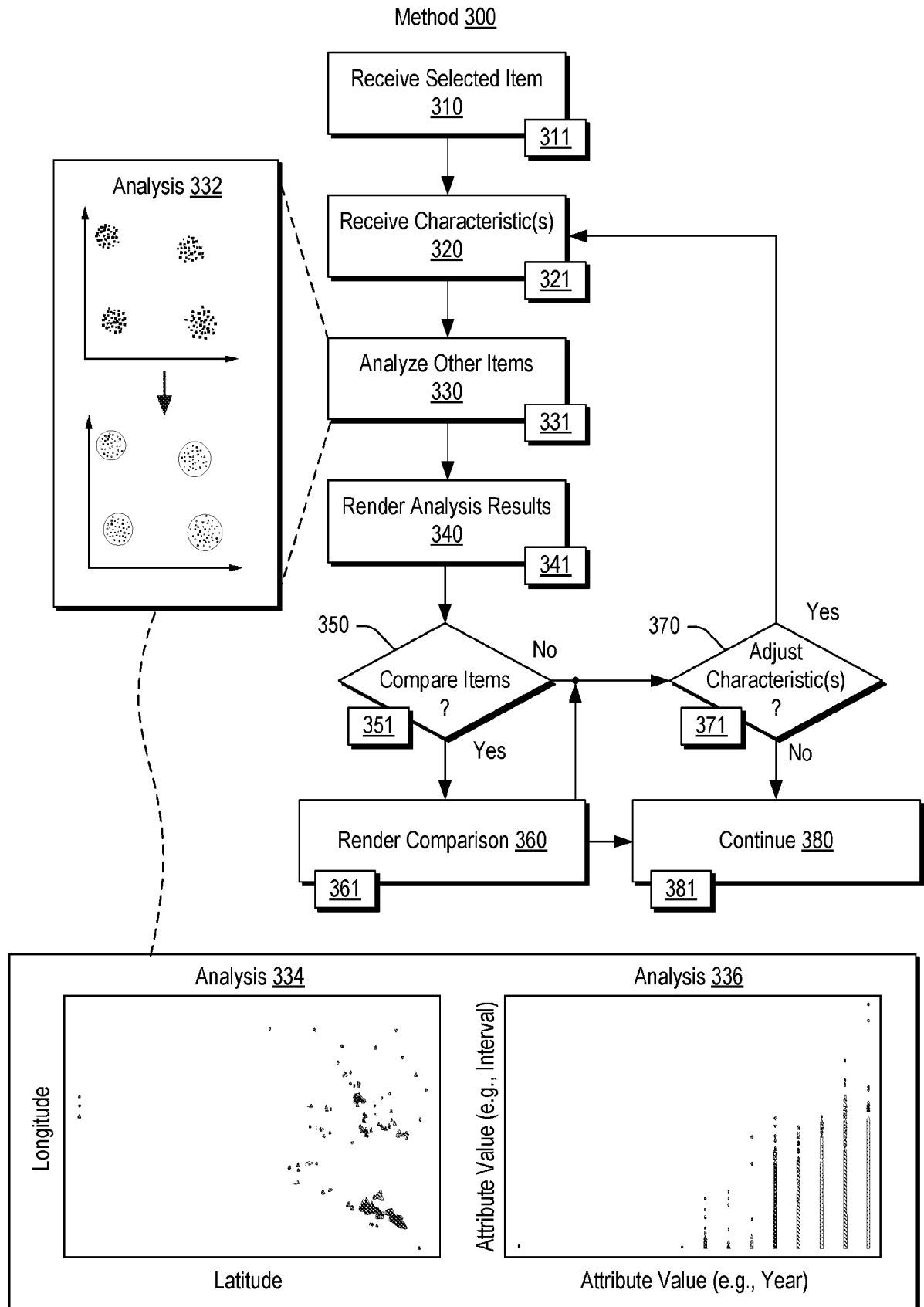


Fig. 3

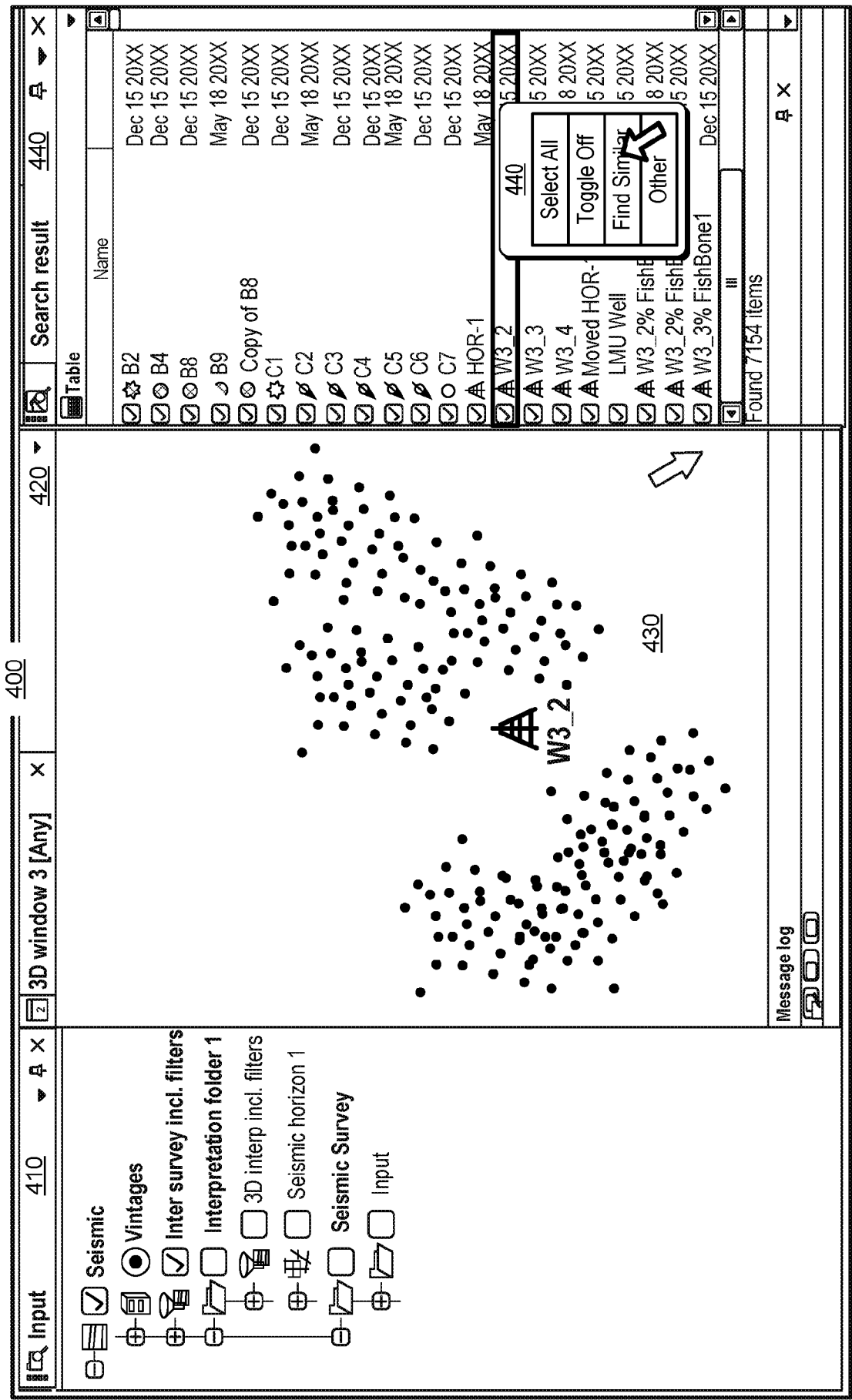


Fig. 4

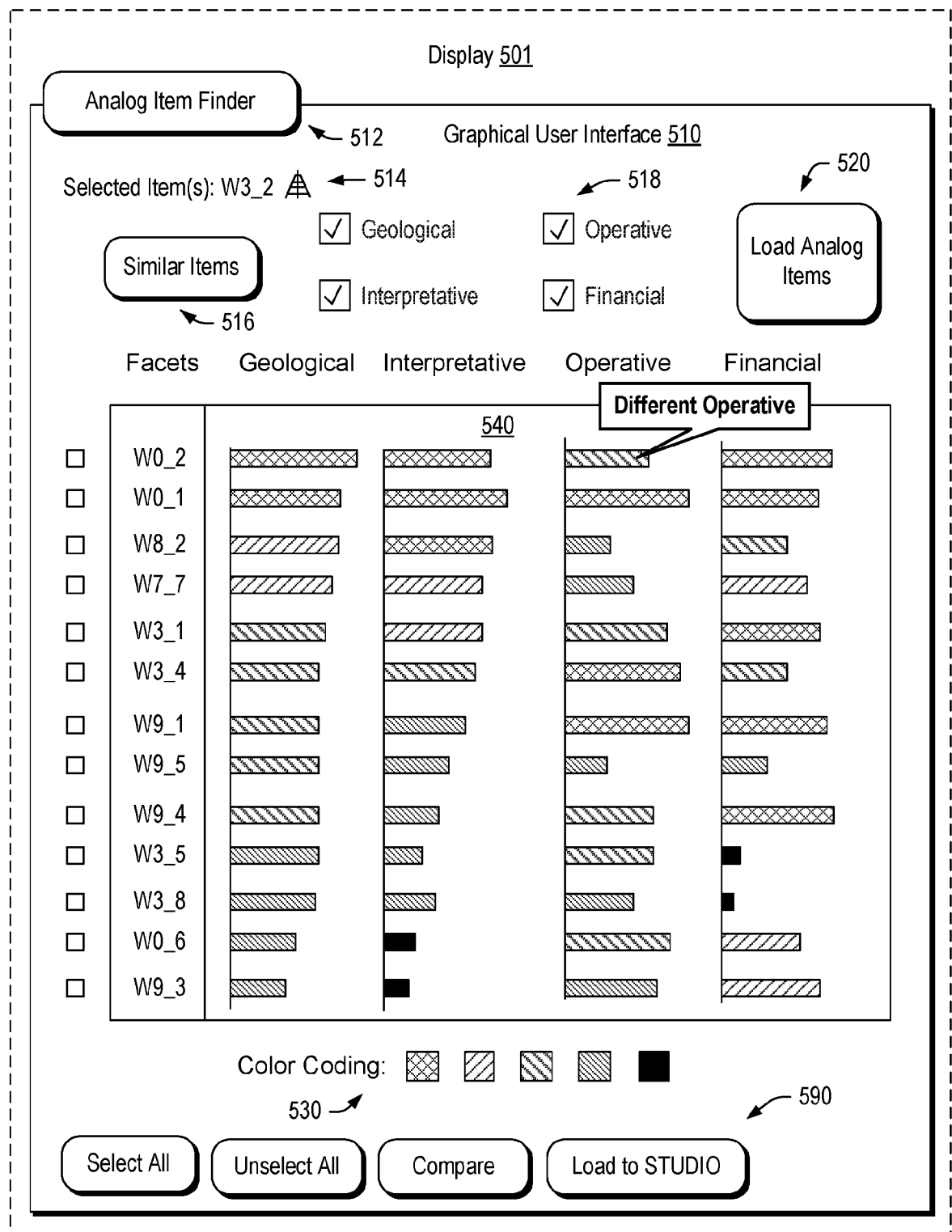


Fig. 5

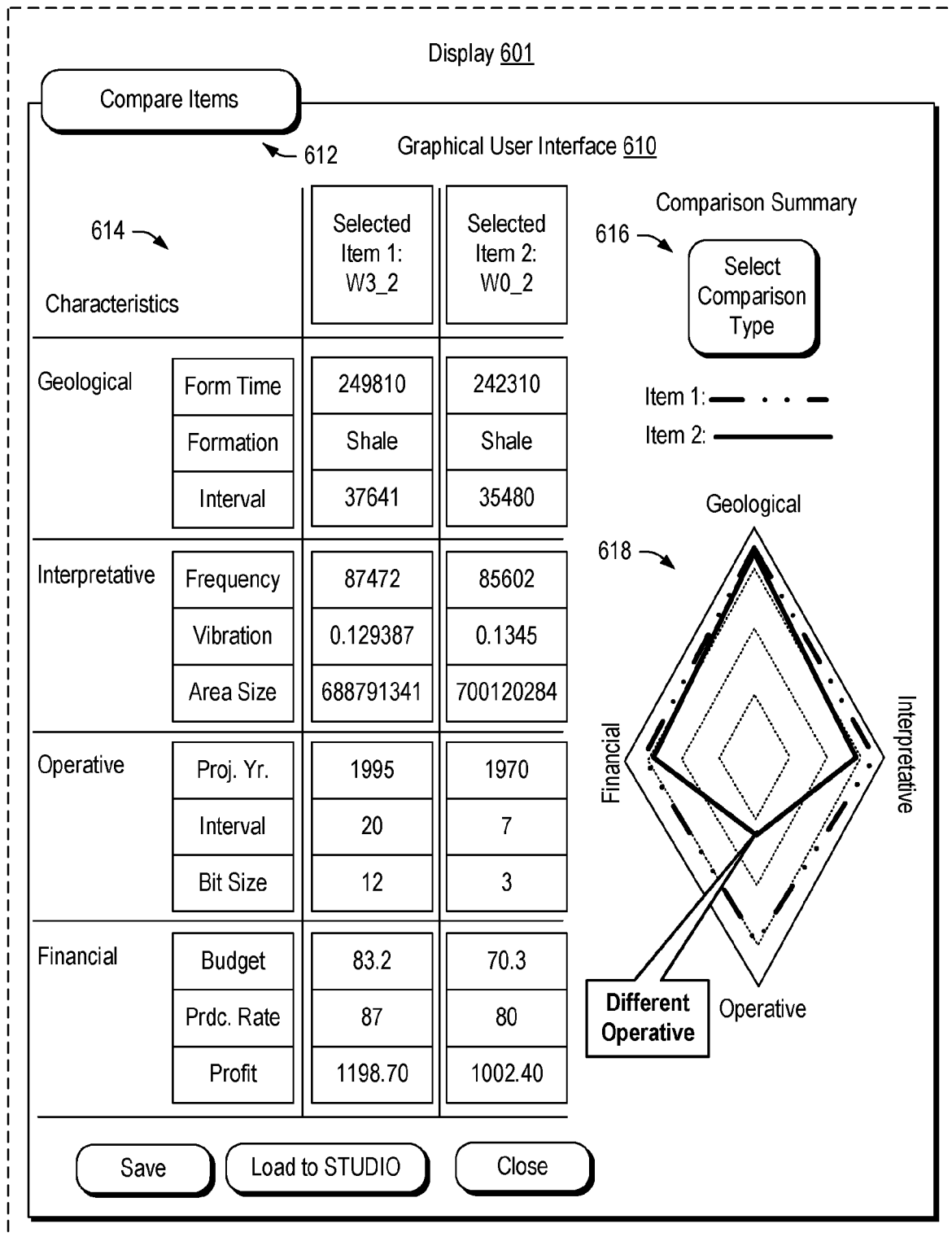


Fig. 6

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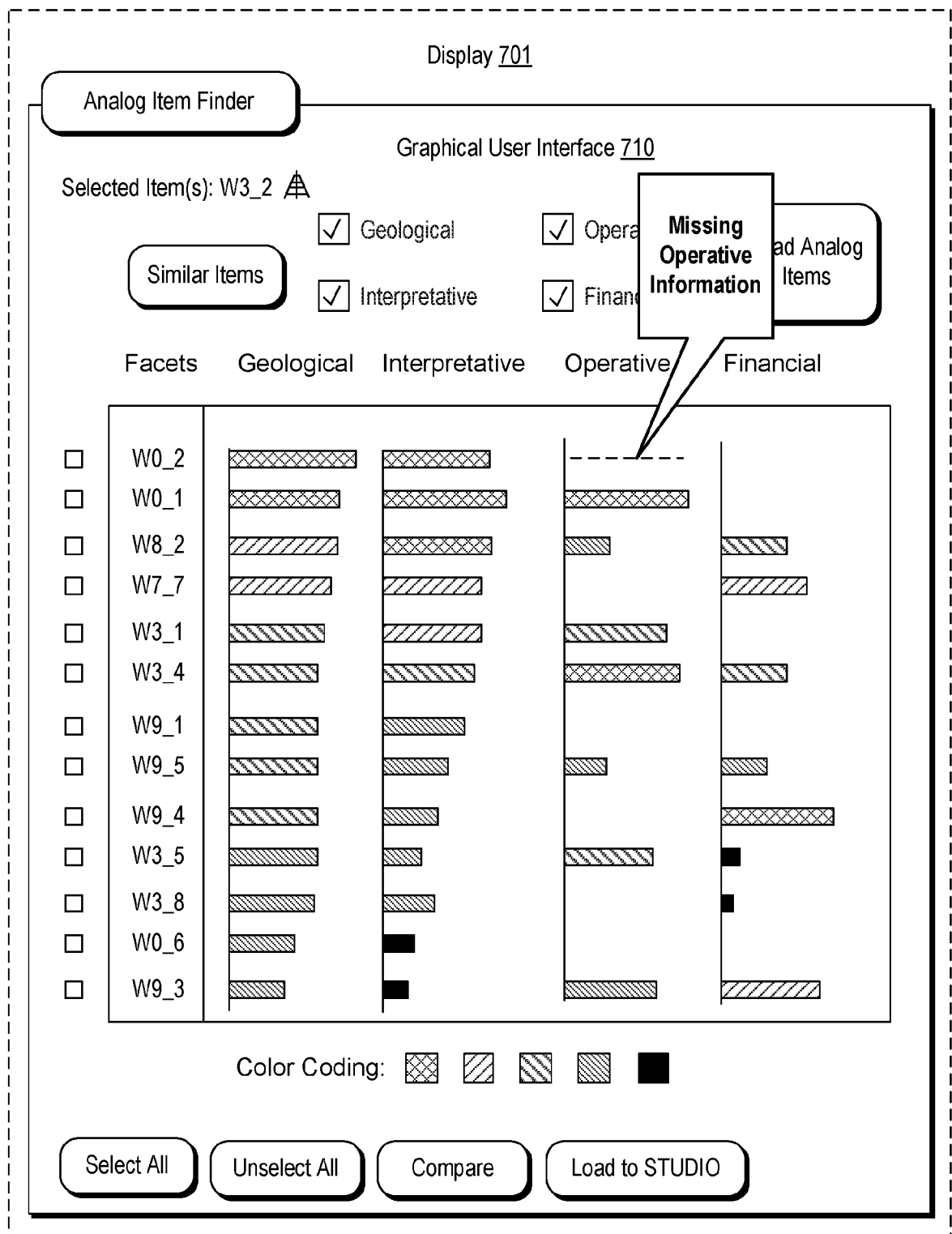


Fig. 7

Example Data 800

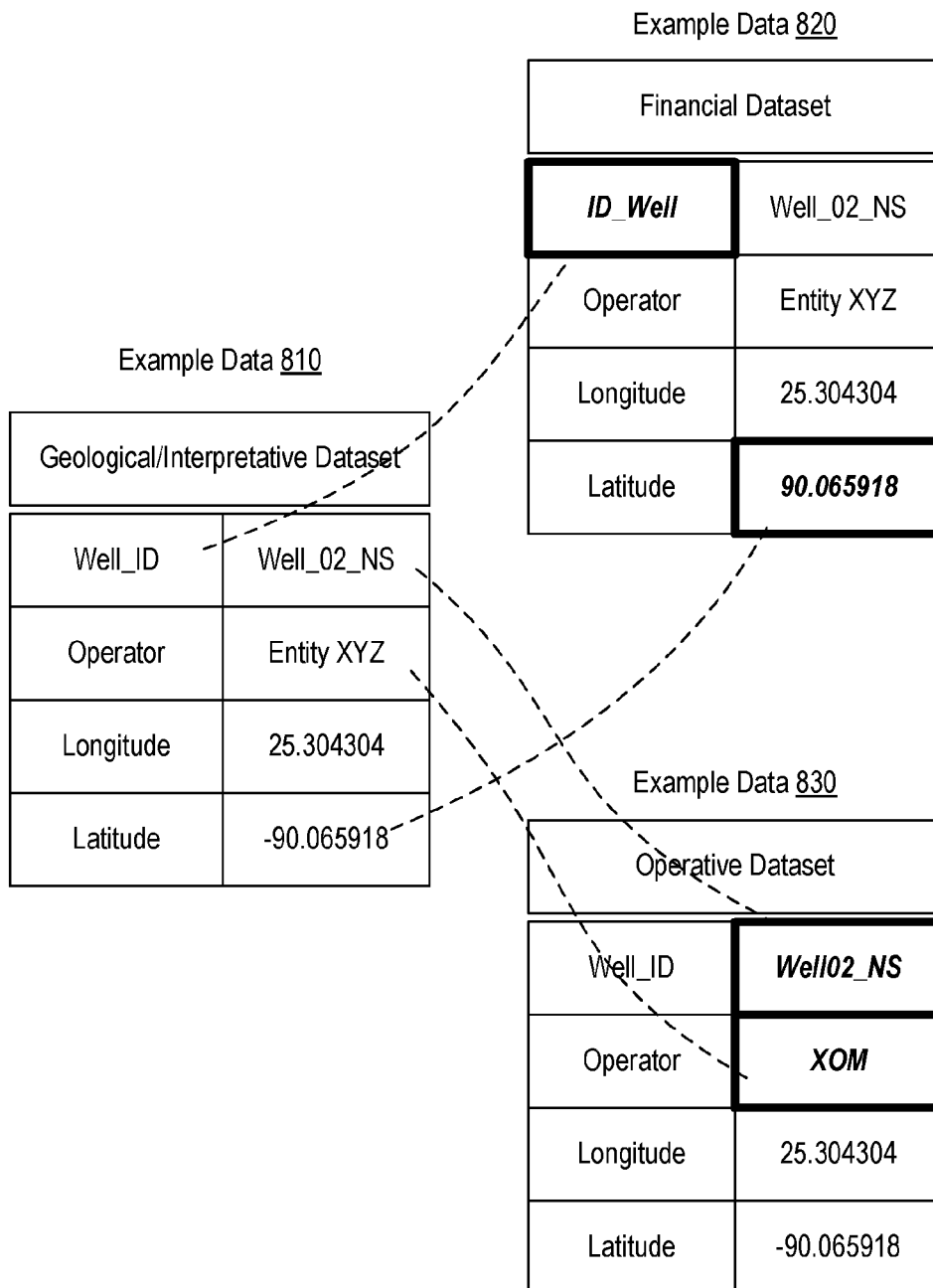


Fig. 8

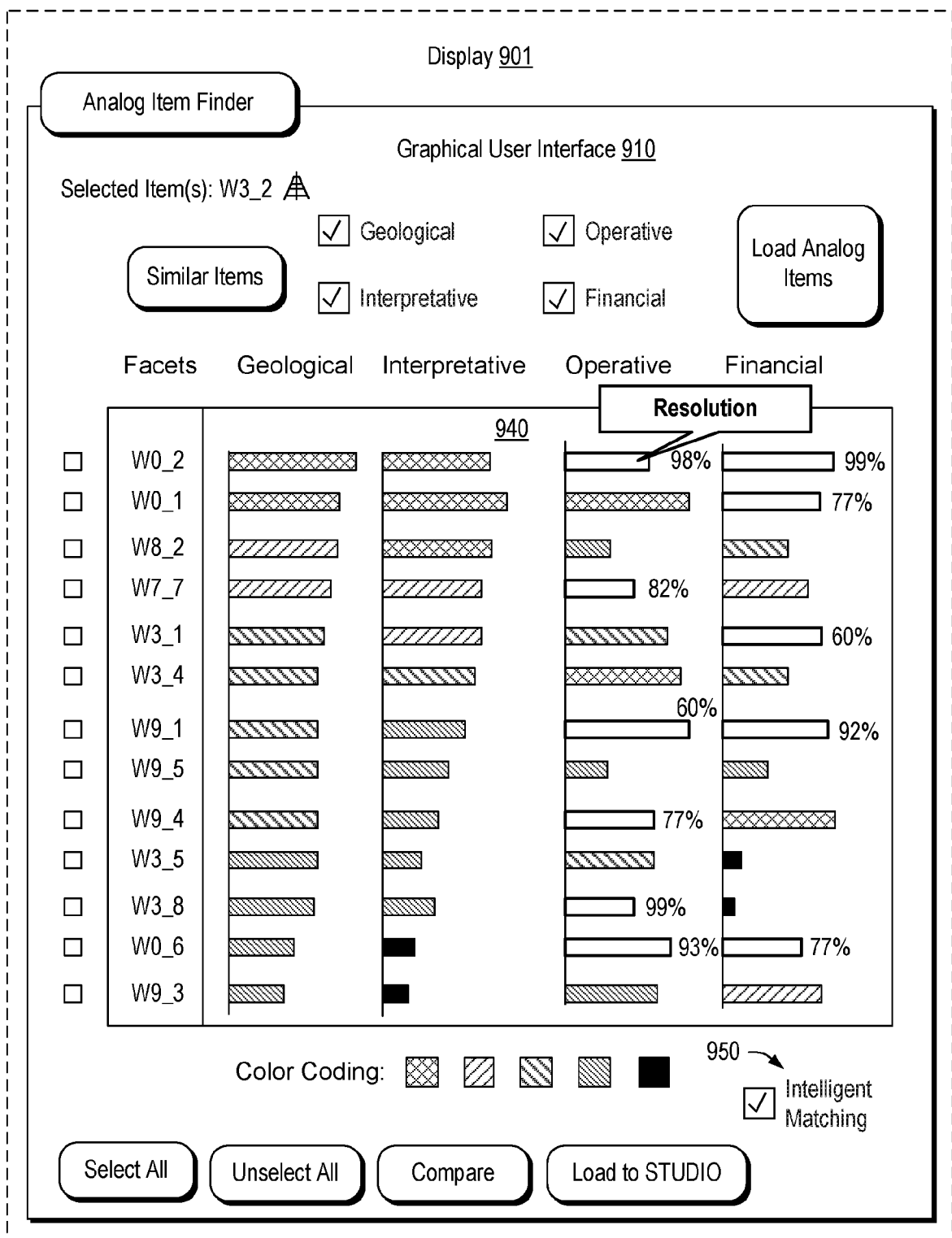


Fig. 9

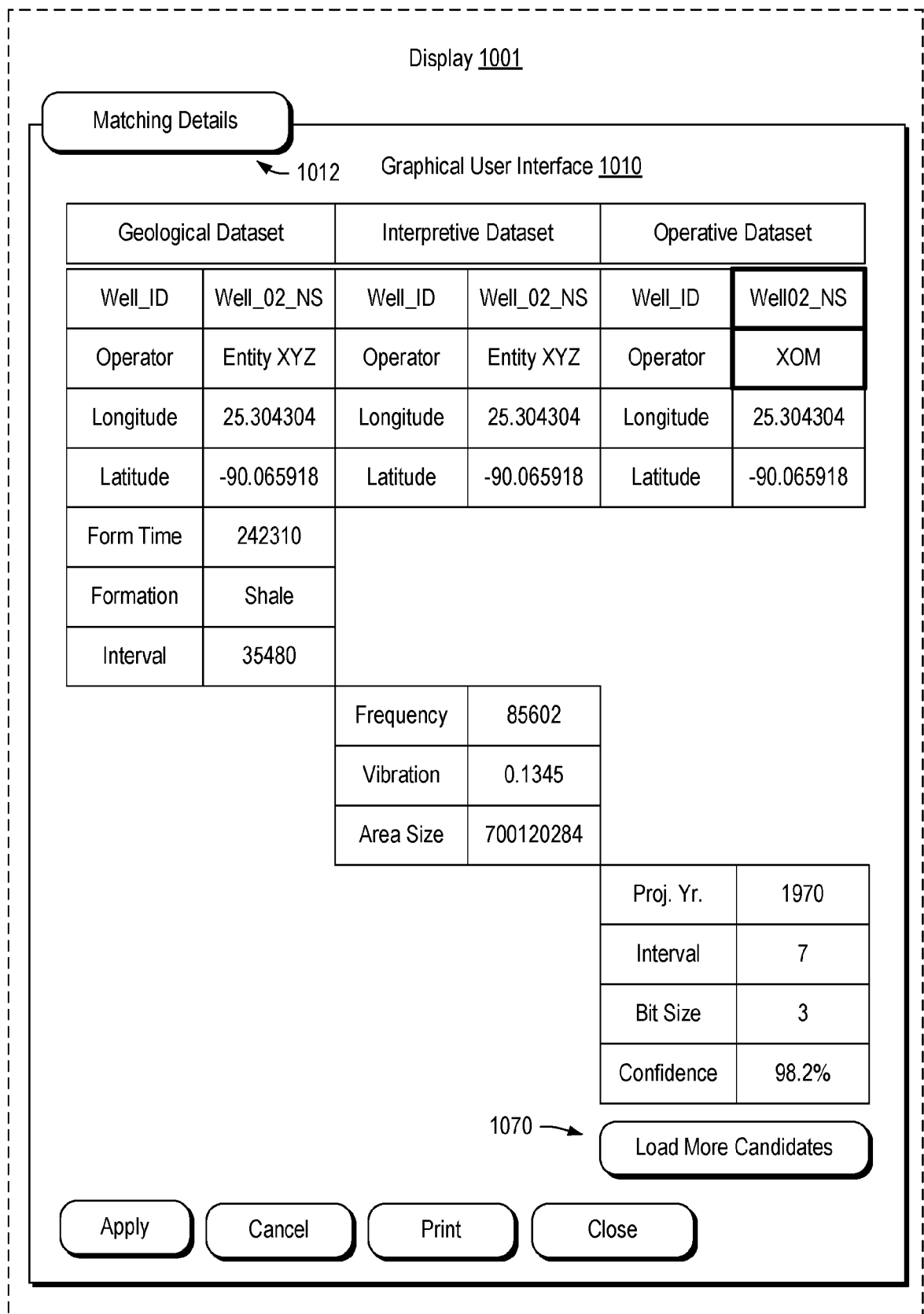


Fig. 10

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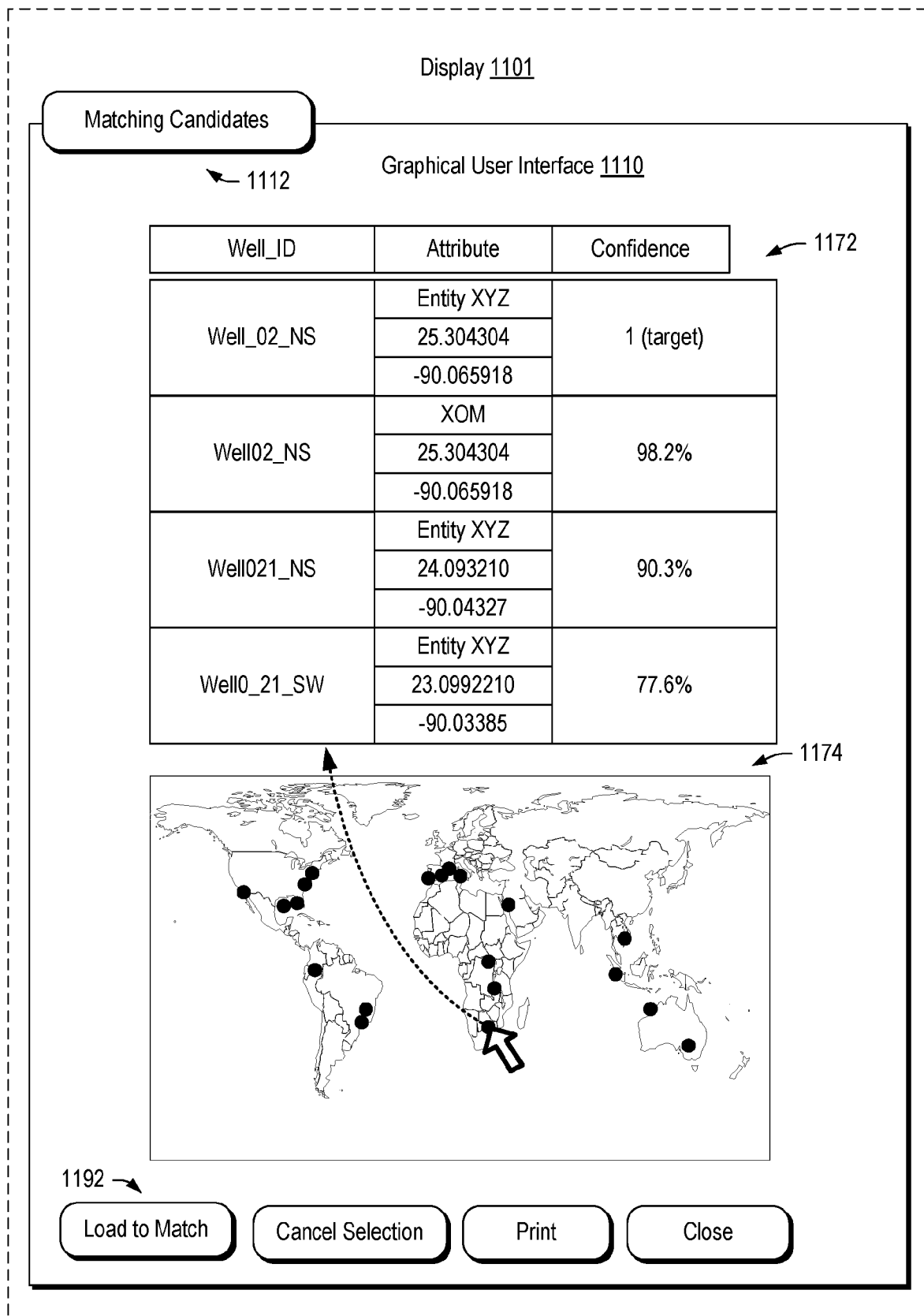


Fig. 11

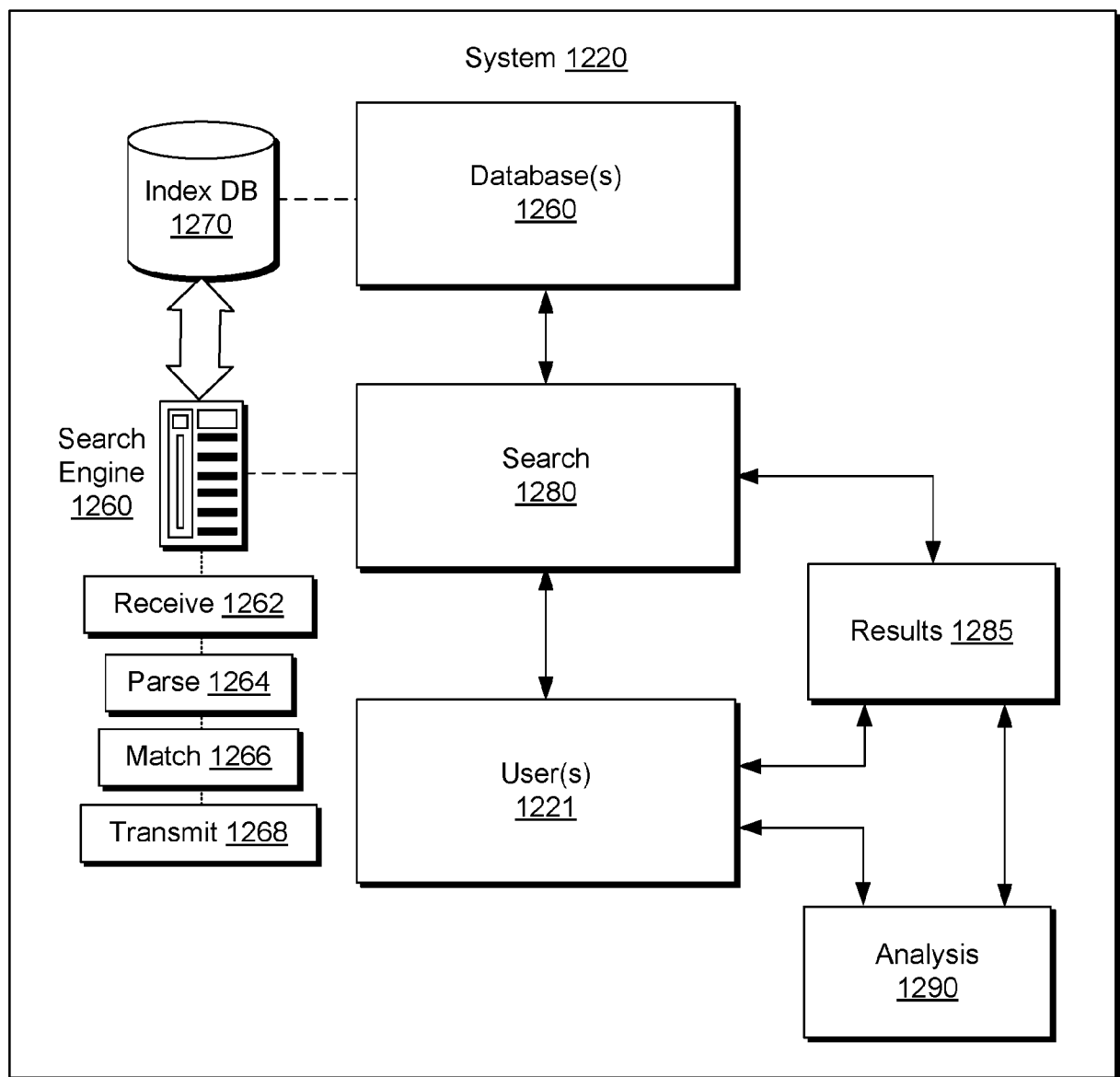
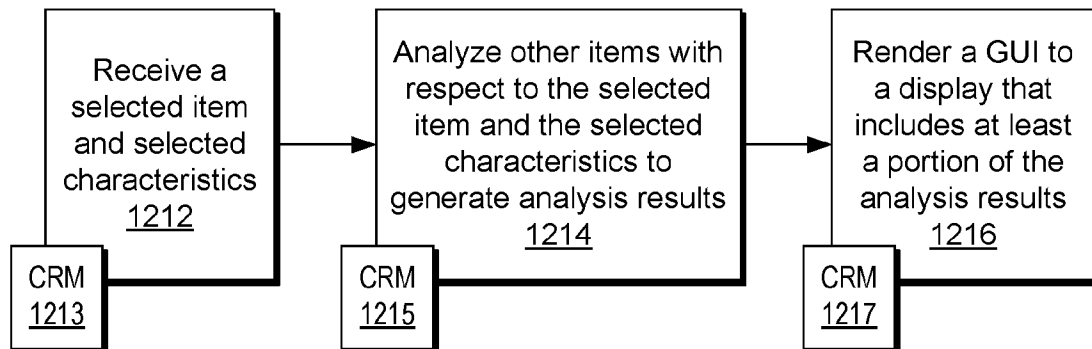
Method 1210

Fig. 12

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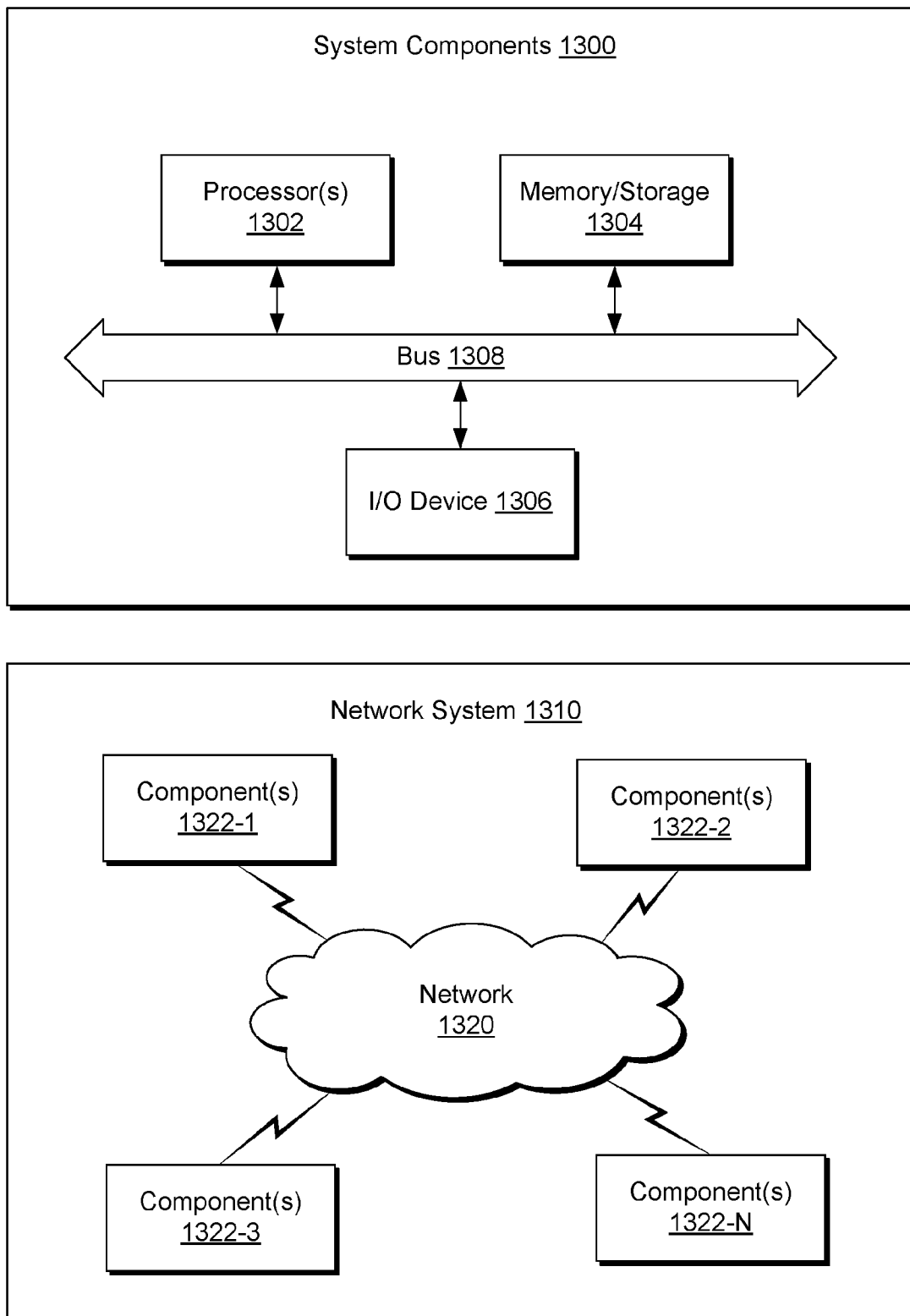


Fig. 13

A. CLASSIFICATION OF SUBJECT MATTER**G01V 1/50(2006.01)i, G01V 1/52(2006.01)i**

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01V 1/50; E21B 7/00; G06F 19/00; G06F 17/18; G06F 17/30; G01V 99/00; G06T 17/05; G06Q 10/00; G01V 1/00; G01V 1/52

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: well, item, characteristic, analyzing, graphical user interface, comparison, table, plot, bar, bar chart array, geological, interpretative, operative, financial

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013-0173165 A1 (BALOGUN et al.) 04 July 2013 See abstract, paragraphs [0051], [0067], claims 1, 11, and figures 5A, 8A-8B.	1-7, 9-20
Y		8
Y	US 2013-0341093 A1 (JARDINE et al.) 26 December 2013 See abstract, paragraphs [0060], [0063], claim 1, and figures 3-4.	8
A	US 8321130 B2 (HILL et al.) 27 November 2012 See abstract, column 5, lines 27-63, and figures 4-6.	1-20
A	US 2015-0073764 A1 (SCHLUMBERGER TECHNOLOGY CORPORATION) 12 March 2015 See abstract, paragraphs [0024]-[0030], claim 1, and figures 1-3.	1-20
A	US 2009-0063230 A1 (BROUSSARD et al.) 05 March 2009 See abstract, paragraphs [0099]-[0101], claim 1, and figure 9.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

11 August 2016 (11.08.2016)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/030507

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