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(71) Applicant *(for all designated States except US)*: **MICROSOFT TECHNOLOGY LICENSING, LLC** [US/US]; One Microsoft Way, Redmond, WA 98052 (US).

(72) Inventors; and

(71) Applicants *(for US only)*: **DANG, Yingnong** [CN/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US). **LIU, Shusen** [CN/CN]; One Microsoft Way, Redmond, Washington 98052-6399 (US). **LIANG, Xiao** [CN/CN]; One Microsoft Way, Redmond, Washington 98052-6399 (US). **ZHANG, Haidong** [CN/CN]; One Microsoft Way, Redmond, Washington 98052-6399 (US). **SUN, Jim** [US/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US). **ZHANG, Dongmei** [CN/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US). **RUBLE, Scott** [US/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US).

(74) Agent: **SHANGHAI PATENT & TRADEMARK LAW OFFICE, LLC**; 435 Guiping Road, Shanghai 200233 (CN).

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(54) Title: AUTOMATIC INSIGHTS FOR SPREADSHEETS

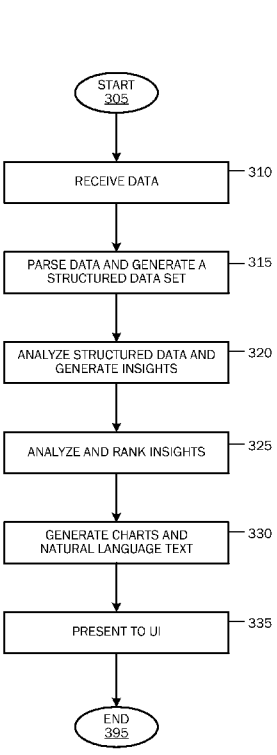


FIG. 3

(57) Abstract: Automatically identifying insights from a dataset and presenting the insights graphically and in natural language text ranked by importance is provided. Different data types and structures in the dataset are automatic recognized and matched with a corresponding specific analysis type. The data is analyzed according to the determined corresponding analysis types, and insights from the analysis are automatically identified. The insights within a given insight type and between insight types are ranked and presented in order of importance in automatically generate charts that visually describe each insight and in natural language text that describes each insight in such a way that it may be understandable to a general audience who may not have a familiarity with statistics.

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AUTOMATIC INSIGHTS FOR SPREADSHEETS

BACKGROUND

[0001] Modern day computer and computer software users use a variety of software applications to perform various tasks, for example, to write, calculate, draw, organize, prepare presentations, send and receive electronic mail, make music, and the like. A user may utilize a spreadsheet application to process and manipulate data, and using spreadsheet functions, to perform many simple to very complex calculations and organizational functions with their data.

[0002] A spreadsheet application is oftentimes used for data analysis; however many of today's tools are manual, meaning that users have to stipulate what type of data they are feeding in and what type of analysis they wish to perform. In addition, users may potentially need to edit their data to conform to the needs of the tool (e.g. rearrange their data into a form recognizable by the tool, express data in a specific format, etc.).

[0003] Some users may experience challenges when trying to identify insights from their data. For example, a dataset may include noisy and/or incomplete data. Noisy data, such as outliers and missing data may make it difficult for a common user to determine meaningful analysis data (e.g., an average value, trend line, etc.).

[0004] A common user may be required to have a certain knowledge base of the application's capabilities and may require a series of complicated steps to perform certain operations. Many common users may have a limited knowledge of principles of statistical graphics or data analysis, which may make it difficult for him/her to identify important

insights. It is with respect to these and other considerations that the present invention has been made.

SUMMARY

[0005] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the detailed description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended as an aid in determining the scope of the claimed subject matter.

[0006] Embodiments of the present invention solve the above and other problems by automatically identifying insights from a dataset and presenting the insights ranked by importance. Embodiments provide for an automatic recognition of different data types and structures (e.g., numerical dataset, time series, ordinal series, hierarchies, categories, etc.), and an automatic matching of these data types and structures with specific analysis types that correspond to them. The automatic recognition may be resilient to errors in the data (e.g. missing values, outliers, etc.) and diversity in the formatting of the data (e.g. the multitude of ways that date/time can be expressed, the different ways that a hierarchy can be laid out, etc.).

[0007] The data may be automatically analyzed according to the determined corresponding analysis types, and insights from the analyses may be automatically identified. An analysis may yield a large number of insights with varying strengths. Embodiments comprise a ranking system operable to determine the strongest insights within a given insight type (e.g., correlations, linear trends, etc.), and also determine

rankings of insights between insight types. Accordingly, a list of insights spanning various insight types and in order of determined importance may be generated.

[0008] Embodiments may comprise an insights presentation engine operable to automatically generate charts that visually describe each insight and natural language text that describes each insight in such a way that it may be understandable to a general audience who may not have a familiarity with statistics. According to embodiments, each chart may be tailored to showcase a specific insight rather than depicting the entire dataset. The text may include headers and values sourced for the user's own data.

[0009] The details of one or more embodiments are set forth in the accompanying drawings and description below. Other features and advantages will be apparent from a reading of the following detailed description and a review of the associated drawings. It is to be understood that the following detailed description is explanatory only and is not restrictive of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[00010] The accompanying drawings, which are incorporated in and constitute a part of this disclosure, illustrate various embodiments of the present invention. In the drawings:

[00011] **FIGURE 1** is a block diagram of one embodiment of a system for automatically identifying insights from a dataset and presenting the insights ranked by importance;

[00012] **FIGURE 2A** is an illustration of an example spreadsheet application user interface comprising a dataset;

[00013] **FIGURE 2B** is an illustration of an example spreadsheet application user interface comprising a listing of insights;

[00014] **FIGURE 2C** is an illustration of an example spreadsheet application user interface where an insight is selected and displayed as a graph;

[00015] **FIGURE 2D** is an illustration of an example spreadsheet application user interface where the graph is inserted into the spreadsheet;

[00016] **FIGURE 3** is a flow chart of a method for automatically identifying insights from a dataset and presenting the insights ranked by importance;

[00017] **FIGURE 4** is a block diagram illustrating example physical components of a computing device with which embodiments of the invention may be practiced;

[00018] **FIGURE 5A** and **5B** are simplified block diagrams of a mobile computing device with which embodiments of the present invention may be practiced; and

[00019] **FIGURE 6** is a simplified block diagram of a distributed computing system in which embodiments of the present invention may be practiced.

DETAILED DESCRIPTION

[00020] Embodiments of the present invention are directed to automatically identifying insights from a dataset and presenting the insights graphically and in natural language text ranked by importance. As described briefly above, different data types and structures in a dataset may be automatically recognized and matched with corresponding specific analysis types. The dataset may be analyzed according to the determined

corresponding analysis types, and insights from the analyses may be automatically identified. The insights within a given insight type and between insight types may be ranked and presented in order of importance in automatically generated charts that visually describe each insight and in natural language text that describes each insight in such a way that it may be understandable to a general audience who may not have a familiarity with statistics.

[00021] The following detailed description refers to the accompanying drawings. Wherever possible, the same reference numbers are used in the drawing and the following description to refer to the same or similar elements. While embodiments of the invention may be described, modifications, adaptations, and other implementations are possible. For example, substitutions, additions, or modifications may be made to the elements illustrated in the drawings, and the methods described herein may be modified by substituting, reordering, or adding stages to the disclosed methods. Accordingly, the following detailed description does not limit the invention, but instead, the proper scope of the invention is defined by the appended claims.

[00022] Referring now to the drawings, in which like numerals represent like elements, various embodiments will be described. **FIGURE 1** is a block diagram illustrating a system architecture **100** for automatically identifying insights from a dataset and presenting the insights ranked by importance. The system architecture **100** includes a computing device **155**. The computing device **155** may be one of a variety of suitable computing devices described below with reference to **FIGURES 4** through **6**. For example, the computing device **155** may include a tablet computing device, a desktop computer, a mobile communication device, a laptop computer, a laptop/tablet hybrid computing device,

a gaming device, or other type of computing device for executing applications **150** for performing a variety of tasks.

[00023] The application **150** illustrated in association with computing device **155** is illustrative of any application having sufficient computer executable instructions for enabling embodiments of the present invention as described herein. For example, application **150** may include spreadsheet applications, word processing applications, slide presentation applications, electronic mail applications, notes taking applications, desktop publishing applications, and the like. An example spreadsheet application **150** includes Excel® manufactured by Microsoft Corporation of Redmond, Washington. As should be appreciated, this example spreadsheet application is but one example of the many applications suitable for enabling embodiments described herein.

[00024] Applications **150** may include thick client applications, which may be stored locally on the computing device **155**, or may include thin client applications (i.e., web applications) that may reside on a remote server and accessible over a network, such as the Internet or an intranet. A thin client application may be hosted in a browser-controlled environment or coded in a browser-supported language and reliant on a common web browser to render the application executable on a computing device **155**.

[00025] The system architecture **100** includes a recognizer **110** configured to perform operations relating to parsing input data **105**, recognizing different data types and structures, and automatically matching these data types and structures with specific analysis types that correspond to them. According to embodiments, the input data **105** may be semi-structured data that may be obtained from a spreadsheet application **150** or other data source. The data **105** may be comprised of data points in a matrix of data cells.

[00026] According to embodiments, the recognizer **110** may be operable to parse the input data **105** and generate a structured dataset **115** such as numerical datasets, time series, ordinal series, hierarchies, categories, etc. The recognizer **110** may be operable to recognize data types such as time series, hierarchical data, categories, etc. The recognizer **110** may also be operable to determine whether a column (or row) containing numerical data is metric or non-metric. For example, a table in a spreadsheet may comprise a column of student IDs represented by identification numbers. A determination may be made by the recognizer **110** that while the values are numeric, they should not be aggregated, and thus may be recognized as non-metric. The automatic recognition may be resilient to errors in the data **105** (e.g. missing values, outliers, etc.) and diversity in the formatting of the data (e.g. the multitude of ways that date/time can be expressed, the different ways that a hierarchy can be laid out, etc.). The recognizer **110** may recognize time series data out of a semi-structured data sheet, wherein a time series data may be defined as a set of numerical values driven by a series of time which has equal intervals (e.g., 1 day, 2 weeks, 3 months, 5 years, etc.). The recognizer **110** may be operable to recognize time series data from data sheets of various formats (e.g., contains one year only, combines two columns/headers to form a time series, etc.). Many spreadsheets may be in a complex structure that can be formulated into a hierarchy structure. The recognizer **110** may be operable to extract complex structures from semi-structured input data **105** and formulate the data **105** into hierarchical-structured data **115**. The recognizer **110** may be further operable to recognize categories within input data **105**. For example, the recognizer **110** may recognize a column or row in a table of data **105** may be a category, such as brands of cars.

[00027] The system architecture **100** includes an insights engine **120** configured to perform operations relating to receiving and analyzing the structured data **115** and

generating insights **125** based on the analyses. The insights engine **120** may be operable to generate insights associated with various types of structured data **115** such as, but not limited to, single numerical datasets, single time series, correlation between two time series, correlation among multiple time series, a hierarchy, a category, etc.

[00028] One type of insight **125** that may be generated from a single numerical dataset may include determining whether a dataset **105** comprises a missing data point. Oftentimes, there may be missing data points in an input dataset **105**. The corresponding cells of these missing data points may be empty or filled with a special number (e.g., 0, -1, -999, etc.). The insights engine **120** may be operable to detect such empty cells or special numbers, and determine if a specific data point is a missing data point.

[00029] Another type of insight **125** that may be generated from a single numerical dataset **115** may include calculating a robust average value of a numerical dataset. An average value is a basic insight about a numerical dataset; however, directly calculating the average value of all data points (excluding any missing data points) may generate a misleading result due to the possibility of outliers which skew a calculated average value. Accordingly, according to an embodiment, the insights engine **120** may use a trimmed mean statistical measure to calculate a robust average value (i.e., a mean value of a numerical dataset excluding the biggest x% and smallest x% values).

[00030] The insights engine **120** may be operable to automatically identify if a numerical dataset **115** comprises any outlier data points. According to an embodiment, the insights engine **120** may calculate a trimmed standard deviation of a dataset, wherein the biggest x% and the smallest x% values are excluded. Robust outliers may be obtained by determining all values outside of a predetermined interval, for example:

$[TM - 3 * TS, TM + 3 * TS]$, wherein TM = trimmed mean and TS = trimmed standard deviation. The number of outliers in a dataset **115** may be used to determine an importance of an outlier type insight **125**.

[00031] Outliers may lead to a skewed distribution of a numerical dataset **115**, which may result in a poor visualization of a common histogram. Accordingly, the insights engine **120** may incorporate a range histogram, which intelligently partitions a skewed distribution into a plurality of segments, wherein each segment has a normal distribution. According to an embodiment, the insights engine **120** may be able to automatically identify if two or more arbitrary distributions are similar.

[00032] The insights engine **120** may be further operable to generate insights **125** associated with single time series. According to embodiments, insights **125** of numerical datasets **115** as described above may also apply to time series datasets **115**. In addition, the following types of insights **125** may be identified for single time series: spikes, jumps, robust linear trend with outliers, segments with different variants, etc.

[00033] A spike in a time series may be identified when a value in a local range is significantly high or low compared with its neighboring data points. A jump in a time series may be identified when an average value of a time series significantly changes at a specific time point. A linear trend of a time series may be detected with consideration on potential outliers.

[00034] The insights engine **120** may utilize a robust linear regression algorithm to detect if there is a linear trend for a time series. The algorithm may be insensitive to outliers. If a linear trend is identified, outliers may be detected against residuals between the time series and the regressed linear trend.

[00035] The insights engine **120** may be operable to identify segments in a time series with different ranges of variations. For example, the range of variation of a time series may change, which may reflect the stability of a time series.

[00036] Sometimes, two time series may have similar evolution patterns (e.g., the value of two time series increase or decrease simultaneously). The insights engine **120** may be operable to identify if two time series are correlated. According to an embodiment, robust linear regression may be utilized, and two time series may be determined to be correlated if the residual of the robust linear regression is small. According to another embodiment, correlation coefficients (e.g., Pearson correlation) may be calculated to detect if two time series may be related.

[00037] As described above, the insights engine **120** may further be operable to detect correlation among multiple time series. The insights engine **120** may detect all correlated time series pairs and then perform clustering to detect possible correlations.

[00038] As described above, the insights engine **120** may be operable to generate insights associated with a hierarchy of data. To gain insights from a hierarchy with numerical attributes associated with each node, the insights engine **120** may determine the difference of the sum value of all children across parent nodes, the difference of the variance of all children across parent nodes, and the difference of the average value of all children across parent nodes.

[00039] Also as described above, the insights engine **120** may be operable to generate insights associated with a category of data. To gain insights from a category, the insights engine **120** may determine a sum of the values across a given category value.

[00040] For a given dataset, **115**, there may be a plurality of insights. Even a small dataset can yield a large number of insights of varying strengths. Presenting all identified insights **125** to a user may be overwhelming to the user. Accordingly, the system **100** may comprise a ranking system **130** operable to rank the identified insights **125** within a given insight type (e.g., correlations, linear trends, etc.) and also between different insight types. For example, the ranking system **130** may be operable to compare the strength of a correlation insight with the strength of a linear trend insight to determine which insight **125** should come before the other in a sequenced list of results.

[00041] Some insights **125** results may be considered fairly strong and significant, while other insights may be considered not as strong and significant. For example, an outlier that is very high above the mean (e.g., 2.5 standard deviations above the mean) may be considered a very strong finding, versus an outlier that falls within 2 standard deviations of the mean. The ranking system **130** may parse through the insights **125** identified by the insights engine **120**, determine the strongest findings via mathematical definitions, then rank the strongest insights across the various insight types. Accordingly, a sequenced list **135** of insights **125** may be generated.

[00042] The system architecture **100** includes an insights presenter **140** configured to perform operations relating to generating a chart **160** visually describing each insight **125** and generating natural language text **165** describing each insight **125** in a descriptive textual string. The chart(s) **160** and natural language text **165** may be provided, and may be presented in an insights user interface (UI) **145** as will be described in more detail with respect to **FIGURES 2A-D**.

[00043] Referring now to **FIGURE 2A**, an example spreadsheet application user interface **200** and spreadsheet document **205** are illustrated that may be displayed on any

suitable computing device **155** described above. According to embodiments, user interaction with the electronic spreadsheet user interface **200** and spreadsheet document **205** may be accomplished via a variety of interaction methods including keyboard entry, mouse entry, gesture entry, voice command, eye tracking, thin air gesture entry, electronic inking entry, and/or combinations thereof. The electronic spreadsheet user interface **200** and spreadsheet document **205** are for purposes of example and illustration only and are not exhaustive of the variety of types of documents that may contain data for which embodiments of the present invention may be utilized. For example, while embodiments described herein discuss automatically identifying insights from a dataset and presenting the insights in association with data contained in a spreadsheet application document **205**, other software applications and associated documents, for example, word processing documents, slide presentation documents, electronic mail documents, notes documents, and the like that are capable of receiving displaying and allowing operation of spreadsheet-type functions may be utilized in accordance with embodiments of the present invention.

[00044] Referring still to **FIGURE 2A**, the example spreadsheet user interface **200** includes data **105**, which may be a semi-structured dataset. In the example spreadsheet document **205**, the data **105** is data sheet comprising a matrix of data cells containing data of a monthly trend of manufacturing, retail sales, and transport from years 2022-2023. According to embodiments, an insights functionality control **220** may be provided which when selected may automatically extract the data **105** and derive and rank insights **125** from the data **105**.

[00045] Referring now to **FIGURE 2B**, the derived and ranked insights **125** are shown displayed in an insights task pane **225**. According to an embodiment, the sequenced listing of insights **135** may dynamically change in response to a selection of data **105** in

the spreadsheet **205**. Each insight **125A-N** in the list **135** may be represented by a natural language text string **165A-N** describing the specific insight. The natural language text **165** may explain the insight **125** in plain terminology such that it may be understandable to a general audience who may not have a familiarity with statistics. The natural language text **165** may include text sourced from the data **105**. According to an embodiment, a descriptive string for a trend insight type may be: "<time_duration>, <column_names> <degree_of_change> from <time_granularity>." For example, the first insight **125A** comprises natural language text string **165A** "In 2023, Manufacturing and Retail Sales increased steadily from month to month."

[00046] Additionally, each insight **125A-N** may comprise an icon **230A-N** descriptive of the insight type (e.g., an increasing, decreasing, or stable trend, a peak or valley, a positive or negative correlation between variables, etc.). For example, the first insight **125A** comprises an icon **230A** showing an increasing trend.

[00047] Interaction with an insight **125** is illustrated **FIGURE 2C**. As shown, on mouse hover or selection, an insight **125** may be highlighted **210**. In addition, the range of cells **255** in the spreadsheet **205** to which the insight **125** pertains may be highlighted. Additionally, on mouse hover or selection, an automatically generated chart **160** that best exemplifies the insight **125** may be displayed. The chart **160** may comprise trend lines, shapes, annotations, or other added features that help make the insight **125** more intuitive, and may also include confidence level data **245** pertaining to an insight **125**. Each insight **125** may have one or more charts **160** that showcase the particular insight.

[00048] As an example and as illustrated in **FIGURE 2C**, a trend-type insight **125** may be expressed with a line chart **160**, where the x-axis may span the duration of the trend and may be delimited by the time granularity (e.g., year to year, month to month, day to

day, etc.), and the y-axis is the value range of the variable. The line chart **160** may also include a linear trend line that fits the slope of the observed trend. The chart **160** may comprise a title **215** that may be a concatenation of the variable column name(s) (e.g., "Manufacturing" and "Retail Sales") and a statement of time (e.g., "2023," "2020-2022," "May-Sept," etc.).

[00049] If a user wishes to insert a chart **160** associated with an insight **125** into the spreadsheet **205**, he/she may select an insert chart functionality control **250**. Accordingly, the chart **160** may be instantiated as a chart in the spreadsheet **205** as illustrated in **FIGURE 2D**.

[00050] **FIGURE 3** is a flow chart showing one embodiment of a method **300** for automatically identifying insights from a dataset and presenting the insights ranked by importance. The method **300** starts at OPERATION **305** and proceeds to OPERATION **310**, where data **105** is received. As described above, the received data **105** may be semi-structured data that may be obtained from a spreadsheet application **150** or other data source. According to an embodiment, the data **105** may be extracted and populated into the recognizer **110** when an indication of a selection of an insights functionality control **220** is received.

[00051] The method **300** may proceed to OPERATION **315**, where the data **105** may be parsed and converted into a structured dataset **115**. According to an embodiment, OPERATION **315** may be performed by the recognizer **110**. As described above, the data **105** may be structured into a numerical dataset, a time series, an ordinal series, a hierarchy, a category, or other type of structured dataset **115**.

[00052] The method **300** may proceed to OPERATION **320**, where the structured data **115** may be analyzed according to analysis types that correspond with the data types and structures, and insights **125** may be identified. For example, for a numerical dataset, the insights engine **120** may automatically identify if any data points are outlier data points.

[00053] The method **300** may proceed to OPERATION **325**, where identified insights **125** may be analyzed and ranked in order of importance. As described above, the ranking system **130** may be operable to rank the identified insights **125** within a given insight type (e.g., correlations, linear trends, etc.) and also between different insight types. For example, the ranking system **130** may be operable to compare the strength of a correlation insight with the strength of a linear trend insight to determine which insight **125** should come before the other in a sequenced list of insights **135**.

[00054] The method **300** proceeds to OPERATION **330**, where a chart **160** visually describing each insight **125** and natural language text **165** describing each insight **125** in a descriptive textual string may be generated. At OPERATION **335**, the chart(s) **160** and natural language text **165** may be presented in an insights user interface (UI) **145**. The insights **125** may be presented in a sequenced order by importance as determined by the ranking system **130**. A user may be able to scroll through and view the various insights **125**, and selectively insert one or more insights **125** into the spreadsheet **205**. The method may end at OPERATION **395**.

[00055] While the invention has been described in the general context of program modules that execute in conjunction with an application program that runs on an operating system on a computer, those skilled in the art will recognize that the invention may also be implemented in combination with other program modules. Generally, program modules

include routines, programs, components, data structures, and other types of structures that perform particular tasks or implement particular abstract data types.

[00056] The embodiments and functionalities described herein may operate via a multitude of computing systems including, without limitation, desktop computer systems, wired and wireless computing systems, mobile computing systems (e.g., mobile telephones, netbooks, tablet or slate type computers, notebook computers, and laptop computers), hand-held devices, multiprocessor systems, microprocessor-based or programmable consumer electronics, minicomputers, and mainframe computers.

[00057] In addition, the embodiments and functionalities described herein may operate over distributed systems (e.g., cloud-based computing systems), where application functionality, memory, data storage and retrieval and various processing functions may be operated remotely from each other over a distributed computing network, such as the Internet or an intranet. User interfaces and information of various types may be displayed via on-board computing device displays or via remote display units associated with one or more computing devices. For example user interfaces and information of various types may be displayed and interacted with on a wall surface onto which user interfaces and information of various types are projected. Interaction with the multitude of computing systems with which embodiments of the invention may be practiced include, keystroke entry, touch screen entry, voice or other audio entry, gesture entry where an associated computing device is equipped with detection (e.g., camera) functionality for capturing and interpreting user gestures for controlling the functionality of the computing device, and the like.

[00058] FIGURES 4-6 and the associated descriptions provide a discussion of a variety of operating environments in which embodiments of the invention may be practiced.

However, the devices and systems illustrated and discussed with respect to **FIGURES 4-6** are for purposes of example and illustration and are not limiting of a vast number of computing device configurations that may be utilized for practicing embodiments of the invention, described herein.

[00059] **FIGURE 4** is a block diagram illustrating physical components (i.e., hardware) of a computing device **400** with which embodiments of the invention may be practiced. The computing device components described below may be suitable for the client device **125** and/or server described above. In a basic configuration, the computing device **400** may include at least one processing unit **402** and a system memory **404**. Depending on the configuration and type of computing device, the system memory **404** may comprise, but is not limited to, volatile storage (e.g., random access memory), non-volatile storage (e.g., read-only memory), flash memory, or any combination of such memories. The system memory **404** may include an operating system **405** and one or more program modules **406** suitable for running software applications **150**, such as a spreadsheet application, and for running one or more of the recognizer **110**, the insights engine **120**, the ranking engine **130**, and the insights presenter **140**. The operating system **405**, for example, may be suitable for controlling the operation of the computing device **400**. Furthermore, embodiments of the invention may be practiced in conjunction with a graphics library, other operating systems, or any other application program and is not limited to any particular application or system. This basic configuration is illustrated in **FIGURE 4** by those components within a dashed line **408**. The computing device **400** may have additional features or functionality. For example, the computing device **400** may also include additional data storage devices (removable and/or non-removable) such as, for example, magnetic disks, optical disks, or tape. Such additional storage is illustrated in **FIGURE 4** by a removable storage device **409** and a non-removable storage device **410**.

[00060] As stated above, a number of program modules and data files may be stored in the system memory **404**. While executing on the processing unit **402**, the program modules **406** may perform processes including, but not limited to, one or more of the stages of the method **300** illustrated in **FIGURE 3**. Other program modules that may be used in accordance with embodiments of the present invention and may include applications such as electronic mail and contacts applications, word processing applications, spreadsheet applications, database applications, slide presentation applications, drawing or computer-aided application programs, etc.

[00061] Furthermore, embodiments of the invention may be practiced in an electrical circuit comprising discrete electronic elements, packaged or integrated electronic chips containing logic gates, a circuit utilizing a microprocessor, or on a single chip containing electronic elements or microprocessors. For example, embodiments of the invention may be practiced via a system-on-a-chip (SOC) where each or many of the components illustrated in **FIGURE 4** may be integrated onto a single integrated circuit. Such an SOC device may include one or more processing units, graphics units, communications units, system virtualization units and various application functionality all of which are integrated (or "burned") onto the chip substrate as a single integrated circuit. When operating via an SOC, the functionality, described herein, with respect to automatically identifying insights from a dataset and presenting the insights ranked by importance may be operated via application-specific logic integrated with other components of the computing device **400** on the single integrated circuit (chip). Embodiments of the invention may also be practiced using other technologies capable of performing logical operations such as, for example, AND, OR, and NOT, including but not limited to mechanical, optical, fluidic, and quantum technologies. In addition, embodiments of the invention may be practiced within a general purpose computer or in any other circuits or systems.

[00062] The computing device **400** may also have one or more input device(s) **412** such as a keyboard, a mouse, a pen, a sound input device, a touch input device, etc. The output device(s) **414** such as a display, speakers, a printer, etc. may also be included. The aforementioned devices are examples and others may be used. The computing device **400** may include one or more communication connections **416** allowing communications with other computing devices **418**. Examples of suitable communication connections **416** include, but are not limited to, RF transmitter, receiver, and/or transceiver circuitry; universal serial bus (USB), parallel, and/or serial ports.

[00063] The term computer readable media as used herein may include computer storage media. Computer storage media may include volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer readable instructions, data structures, or program modules. The system memory **404**, the removable storage device **409**, and the non-removable storage device **410** are all computer storage media examples (i.e., memory storage.) Computer storage media may include RAM, ROM, electrically erasable read-only memory (EEPROM), flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other article of manufacture which can be used to store information and which can be accessed by the computing device **400**. Any such computer storage media may be part of the computing device **400**. Computer storage media does not include a carrier wave or other propagated or modulated data signal.

[00064] Communication media may be embodied by computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and includes any information delivery media.

The term "modulated data signal" may describe a signal that has one or more characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media may include wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency (RF), infrared, and other wireless media.

[00065] FIGURES 5A and 5B illustrate a mobile computing device 500, for example, a mobile telephone, a smart phone, a tablet personal computer, a laptop computer, and the like, with which embodiments of the invention may be practiced. With reference to FIGURE 5A, one embodiment of a mobile computing device 500 for implementing the embodiments is illustrated. In a basic configuration, the mobile computing device 500 is a handheld computer having both input elements and output elements. The mobile computing device 500 typically includes a display 505 and one or more input buttons 510 that allow the user to enter information into the mobile computing device 500. The display 505 of the mobile computing device 500 may also function as an input device (e.g., a touch screen display). If included, an optional side input element 515 allows further user input. The side input element 515 may be a rotary switch, a button, or any other type of manual input element. In alternative embodiments, mobile computing device 500 may incorporate more or less input elements. For example, the display 505 may not be a touch screen in some embodiments. In yet another alternative embodiment, the mobile computing device 500 is a portable phone system, such as a cellular phone. The mobile computing device 500 may also include an optional keypad 535. Optional keypad 535 may be a physical keypad or a "soft" keypad generated on the touch screen display. In various embodiments, the output elements include the display 505 for showing a graphical user interface (GUI), a visual indicator 520 (e.g., a light emitting diode), and/or an audio transducer 525 (e.g., a speaker). In some embodiments, the mobile computing device 500

incorporates a vibration transducer for providing the user with tactile feedback. In yet another embodiment, the mobile computing device **500** incorporates input and/or output ports, such as an audio input (e.g., a microphone jack), an audio output (e.g., a headphone jack), and a video output (e.g., a HDMI port) for sending signals to or receiving signals from an external device.

[00066] **FIGURE 5B** is a block diagram illustrating the architecture of one embodiment of a mobile computing device. That is, the mobile computing device **500** can incorporate a system (i.e., an architecture) **502** to implement some embodiments. In one embodiment, the system **502** is implemented as a "smart phone" capable of running one or more applications (e.g., browser, e-mail, calendaring, contact managers, messaging clients, games, and media clients/players). In some embodiments, the system **502** is integrated as a computing device, such as an integrated personal digital assistant (PDA) and wireless phone.

[00067] One or more application programs **150** and one or more of the recognizer **110**, the insights engine **120**, the rating system **130**, and the insights presenter **140** may be loaded into the memory **562** and run on or in association with the operating system **564**. Examples of the application programs include phone dialer programs, e-mail programs, personal information management (PIM) programs, word processing programs, spreadsheet programs, Internet browser programs, messaging programs, and so forth. The system **502** also includes a non-volatile storage area **568** within the memory **562**. The non-volatile storage area **568** may be used to store persistent information that should not be lost if the system **502** is powered down. The application programs **150** may use and store information in the non-volatile storage area **568**, such as e-mail or other messages used by an e-mail application, and the like. A synchronization application (not shown) also resides

on the system **502** and is programmed to interact with a corresponding synchronization application resident on a host computer to keep the information stored in the non-volatile storage area **568** synchronized with corresponding information stored at the host computer. As should be appreciated, other applications may be loaded into the memory **562** and run on the mobile computing device **500**.

[00068] The system **502** has a power supply **570**, which may be implemented as one or more batteries. The power supply **570** might further include an external power source, such as an AC adapter or a powered docking cradle that supplements or recharges the batteries.

[00069] The system **502** may also include a radio **572** that performs the function of transmitting and receiving radio frequency communications. The radio **572** facilitates wireless connectivity between the system **502** and the "outside world," via a communications carrier or service provider. Transmissions to and from the radio **572** are conducted under control of the operating system **564**. In other words, communications received by the radio **572** may be disseminated to the application programs **150** via the operating system **564**, and vice versa.

[00070] The visual indicator **520** may be used to provide visual notifications and/or an audio interface **574** may be used for producing audible notifications via the audio transducer **525**. In the illustrated embodiment, the visual indicator **520** is a light emitting diode (LED) and the audio transducer **525** is a speaker. These devices may be directly coupled to the power supply **570** so that when activated, they remain on for a duration dictated by the notification mechanism even though the processor **560** and other components might shut down for conserving battery power. The LED may be programmed to remain on indefinitely until the user takes action to indicate the powered-on status of

the device. The audio interface **574** is used to provide audible signals to and receive audible signals from the user. For example, in addition to being coupled to the audio transducer **525**, the audio interface **574** may also be coupled to a microphone to receive audible input, such as to facilitate a telephone conversation. In accordance with embodiments of the present invention, the microphone may also serve as an audio sensor to facilitate control of notifications, as will be described below. The system **502** may further include a video interface **576** that enables an operation of an on-board camera **530** to record still images, video stream, and the like.

[00071] A mobile computing device **500** implementing the system **502** may have additional features or functionality. For example, the mobile computing device **500** may also include additional data storage devices (removable and/or non-removable) such as, magnetic disks, optical disks, or tape. Such additional storage is illustrated in **FIGURE 5B** by the non-volatile storage area **568**.

[00072] Data/information generated or captured by the mobile computing device **500** and stored via the system **502** may be stored locally on the mobile computing device **500**, as described above, or the data may be stored on any number of storage media that may be accessed by the device via the radio **572** or via a wired connection between the mobile computing device **500** and a separate computing device associated with the mobile computing device **500**, for example, a server computer in a distributed computing network, such as the Internet. As should be appreciated such data/information may be accessed via the mobile computing device **500** via the radio **572** or via a distributed computing network. Similarly, such data/information may be readily transferred between computing devices for storage and use according to well-known data/information transfer and storage means, including electronic mail and collaborative data/information sharing systems.

[00073] FIGURE 6 illustrates one embodiment of the architecture of a system for automatically identifying insights from a dataset and presenting the insights ranked by importance, as described above. Content developed, interacted with, or edited in association with the recognizer 110, the insights engine 120, the ranking system 130, the insights presenter 140, or the application 150 may be stored in different communication channels or other storage types. For example, various documents may be stored using a directory service 622, a web portal 624, a mailbox service 626, an instant messaging store 628, or a social networking site 630. The recognizer 110, the insights engine 120, the ranking system 130, the insights presenter 140, or the application 150 may use any of these types of systems or the like for automatically identifying insights from a dataset and presenting the insights ranked by importance, as described herein. A server 130 may provide the recognizer 110, the insights engine 120, the ranking system 130, the insights presenter 140, or the application 150 to clients 125. As one example, the server 130 may be a web server providing the recognizer 110, the insights engine 120, the ranking system 130, the insights presenter 140, or the application 150 over the web. The server 130 may provide the recognizer 110, the insights engine 120, the ranking system 130, the insights presenter 140, or the application 150 over the web to clients 125 through a network 140. By way of example, the client computing device 125 may be implemented and embodied in a personal computer 605A, a tablet computing device 605B and/or a mobile computing device 605C (e.g., a smart phone), or other computing device. Any of these embodiments of the client computing device may obtain content from the store 616.

[00074] Embodiments of the present invention, for example, are described above with reference to block diagrams and/or operational illustrations of methods, systems, and computer program products according to embodiments of the invention. The functions/acts noted in the blocks may occur out of the order as shown in any flowchart.

For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved.

[00075] The description and illustration of one or more embodiments provided in this application are not intended to limit or restrict the scope of the invention as claimed in any way. The embodiments, examples, and details provided in this application are considered sufficient to convey possession and enable others to make and use the best mode of claimed invention. The claimed invention should not be construed as being limited to any embodiment, example, or detail provided in this application. Regardless of whether shown and described in combination or separately, the various features (both structural and methodological) are intended to be selectively included or omitted to produce an embodiment with a particular set of features. Having been provided with the description and illustration of the present application, one skilled in the art may envision variations, modifications, and alternate embodiments falling within the spirit of the broader aspects of the general inventive concept embodied in this application that do not depart from the broader scope of the claimed invention.

We claim:

1. A method for providing insights, the method comprising:

receiving data;

determining a structure of the data;

analyzing the data according to the structure of the data;

identifying one or more insights; and

presenting the one or more insights.

2. The method of claim 1, wherein receiving data comprises receiving semi-structured data from a spreadsheet or other data source.

3. The method of claim 1, wherein determining a structure of the data comprises determining one or more of:

a numerical dataset;

a time series;

an ordinal series;

a hierarchy; or

a category.

4. The method of claim 1, further comprising ranking the one or more insights according to a strength of each insight within a given insight type and between insight types.

5. The method of claim 1, wherein presenting the one or more insights comprises:

generating a chart visually describing each insight;

generating natural language text describing each insight; and

presenting the one or more insights in a sequenced list.

6. The method of claim 5, wherein presenting the one or more insights in a sequenced list comprises presenting the one or more insights in a sequenced list ranked by strength of each insight within a given insight type and between insight types.

7. The method of claim 5, further comprising:

receiving an indication of a selection of an insight from the sequenced list; and

displaying the chart visually describing the insight and the natural language text describing the insight.

8. The method of claim 7, further comprising highlighting the data to which the insight pertains in a spreadsheet.

9. The method of claim 7, further comprising:

receiving an indication of a selection to insert the chart; and

inserting the chart into a spreadsheet.

10. A system for providing insights, the system comprising:

one or more processors; and

a memory coupled to the one or more processors, the one or more processors operable to:

receive data;

determine a structure of the data;

analyze the data according to the structure of the data;

identify one or more insights; and

present the one or more insights.

11. The system of claim 10, wherein the data comprises semi-structured data from a spreadsheet or other data source.

12. The system of claim 10, wherein the one or more processors are further operable to ranking the one or more insights according to a strength of each insight within a given insight type and between insight types.

13. The system of claim 10, wherein in presenting the one or more insights, the one or more processors are further operable to:

generate a chart visually describing each insight;

generate natural language text describing each insight; and

present the one or more insights in a sequenced list.

14. The system of claim 13, wherein in presenting the one or more insights in a sequenced list, the one or more processors are further operable to present the one or more insights in a sequenced list ranked by strength of each insight within a given insight type and between insight types.

15. The system of claim 13, wherein the one or more processors are further operable to:

receive an indication of a selection of an insight from the sequenced list; and

display the chart visually describing the insight and the natural language text describing the insight.

16. The system of claim 15, wherein the one or more processors are further operable to:

receive an indication of a selection to insert the chart; and

insert the chart into a spreadsheet.

17. A computer readable medium containing computer executable instructions which, when executed by a computer, perform a method for providing insights, the method comprising:

receiving semi-structured data;

determining a structure of the data;

analyzing the data according to the structure of the data;

identifying one or more insights;

ranking the one or more insights according to a strength of each insight within a given insight type and between insight types.

generating a chart visually describing each insight;

generating natural language text describing each insight; and

presenting the one or more insights in a sequenced list according to the ranking of the insight.

18. The computer readable medium of claim 17, wherein determining a structure of the data comprises determining one or more of:

a numerical dataset;

a time series;

an ordinal series;

a hierarchy; or

a category.

19. The computer readable medium of claim 17, further comprising:

receiving an indication of a selection of an insight from the sequenced list; and

displaying the chart visually describing the insight and the natural language text describing the insight.

20. The computer readable medium of claim 19, further comprising:

receiving an indication of a selection to insert the chart; and

inserting the chart into a spreadsheet.

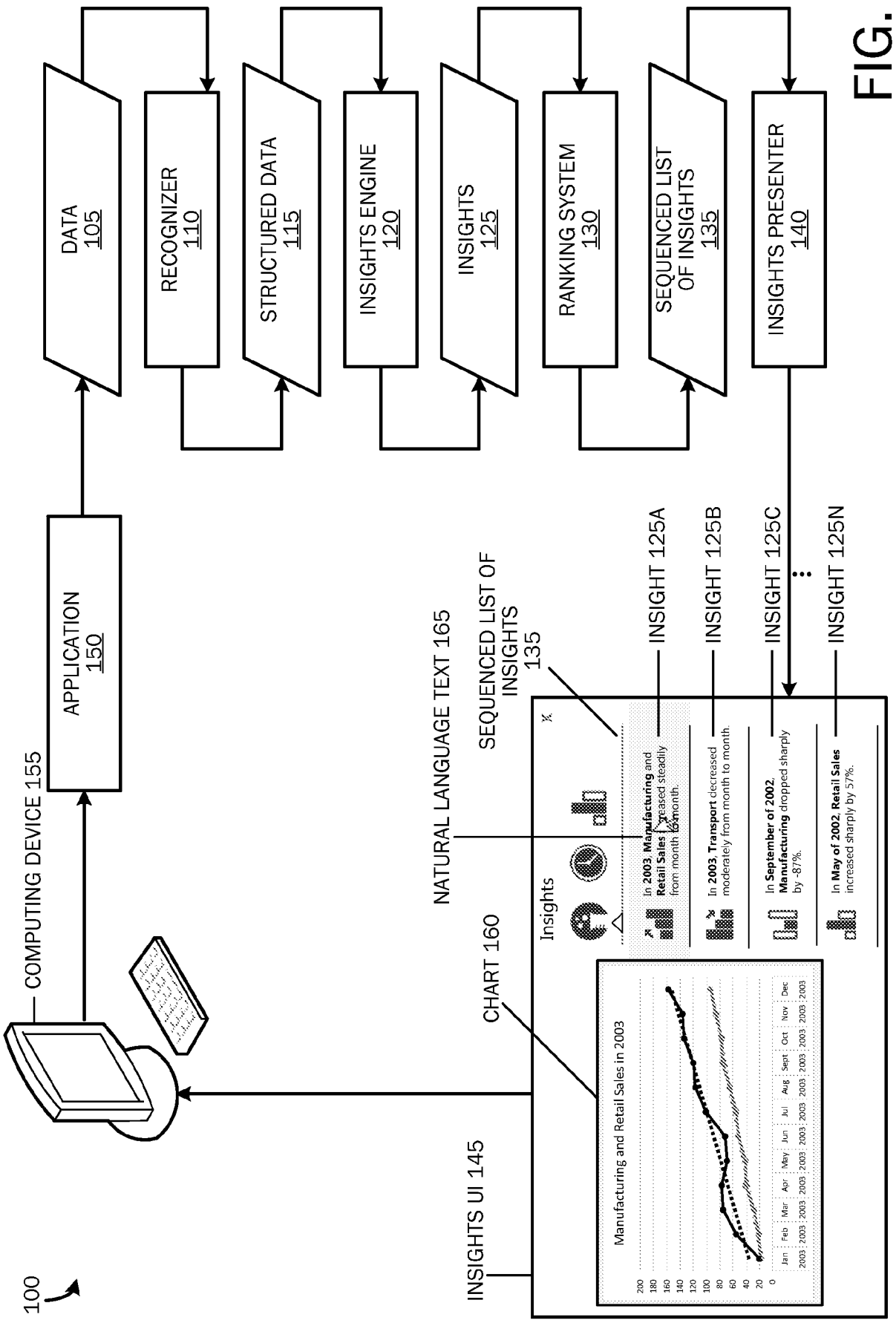
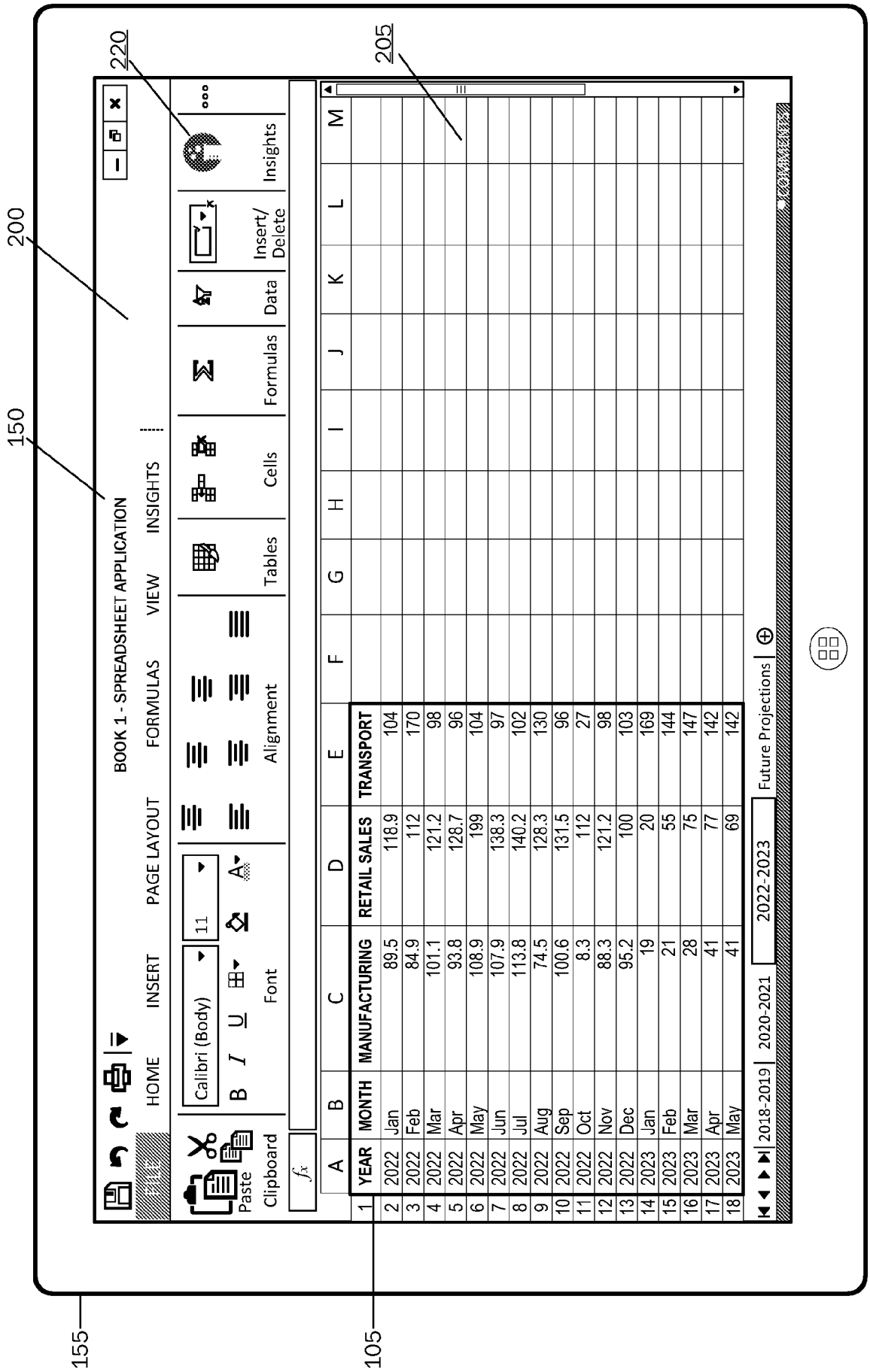
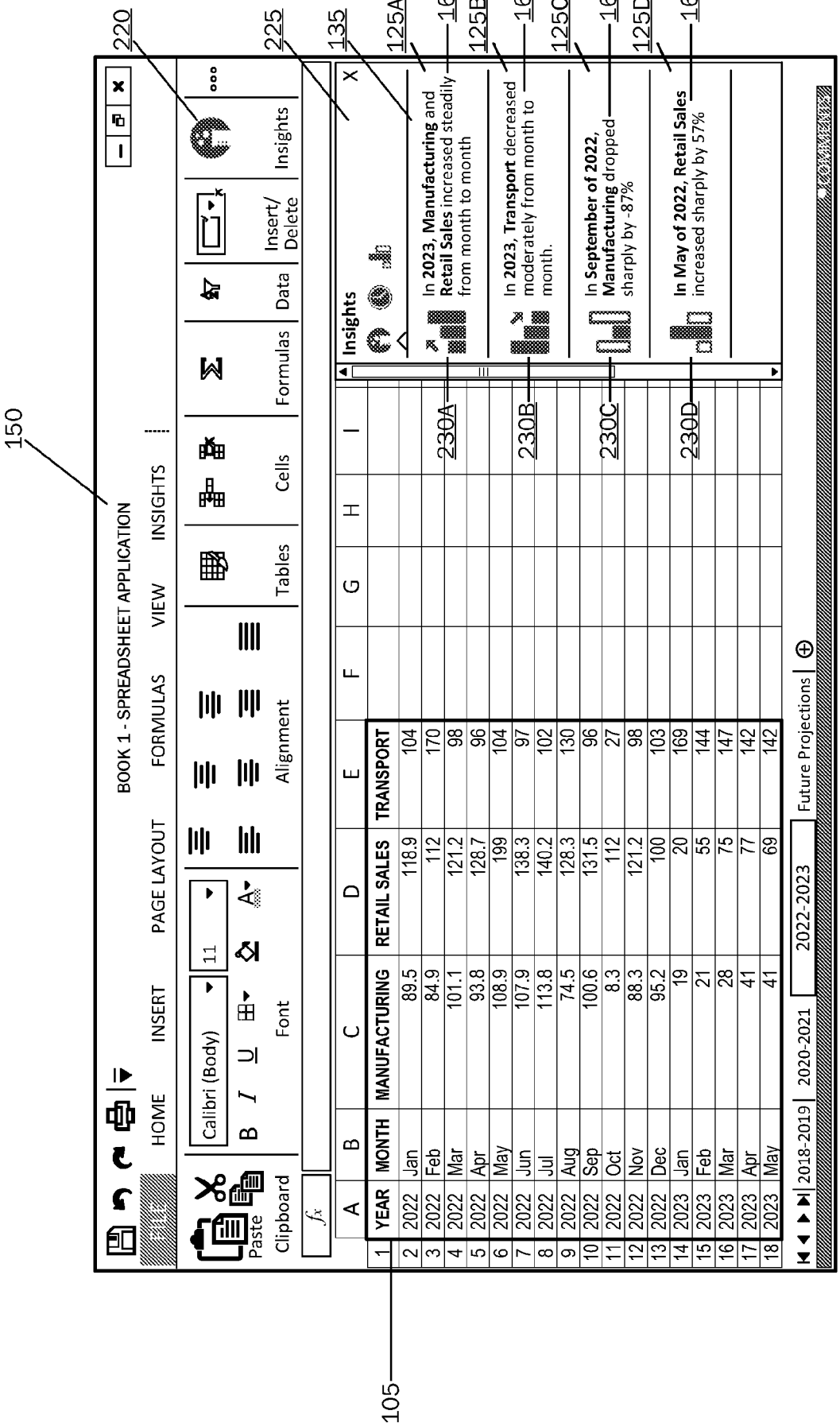

100
COMPUTING DEVICE 155
APPLICATION 150
DATA 105
RECOGNIZER 110
STRUCTURED DATA 115
INSIGHTS ENGINE 120
INSIGHTS 125
RANKING SYSTEM 130
SEQUENCED LIST OF INSIGHTS 135
INSIGHTS PRESENTER 140
INSIGHTS UI 145
CHART 160
NATURAL LANGUAGE TEXT 165
SEQUENCED LIST OF INSIGHTS 135
INSIGHT 125A
INSIGHT 125B
INSIGHT 125C
INSIGHT 125N
Insights
In 2003, Manufacturing and Retail Sales increased steadily from month to month.
In 2003, Transport decreased moderately from month to month.
In September of 2002, Manufacturing dropped sharply by -87%.
In May of 2002, Retail Sales increased sharply by 57%.
Manufacturing and Retail Sales in 2003

FIG. 1



	A	B	C	D	E
1	YEAR	MONTH	MANUFACTURING	RETAIL SALES	TRANSPORT
2	2022	Jan	89.5	118.9	104
3	2022	Feb	84.9	112	170
4	2022	Mar	101.1	121.2	98
5	2022	Apr	93.8	128.7	96
6	2022	May	108.9	199	104
7	2022	Jun	107.9	138.3	97
8	2022	Jul	113.8	140.2	102
9	2022	Aug	74.5	128.3	130
10	2022	Sep	100.6	131.5	96
11	2022	Oct	8.3	112	27
12	2022	Nov	88.3	121.2	98
13	2022	Dec	95.2	100	103
14	2023	Jan	19	20	169
15	2023	Feb	21	55	144
16	2023	Mar	28	75	147
17	2023	Apr	41	77	142
18	2023	May	41	69	142

FIG. 2A



	A	B	C	D	E
1	YEAR	MONTH	MANUFACTURING	RETAIL SALES	TRANSPORT
2	2022	Jan	89.5	118.9	104
3	2022	Feb	84.9	112	170
4	2022	Mar	101.1	121.2	98
5	2022	Apr	93.8	128.7	96
6	2022	May	108.9	199	104
7	2022	Jun	107.9	138.3	97
8	2022	Jul	113.8	140.2	102
9	2022	Aug	74.5	128.3	130
10	2022	Sep	100.6	131.5	96
11	2022	Oct	8.3	112	27
12	2022	Nov	88.3	121.2	98
13	2022	Dec	95.2	100	103
14	2023	Jan	19	20	169
15	2023	Feb	21	55	144
16	2023	Mar	28	75	147
17	2023	Apr	41	77	142
18	2023	May	41	69	142

FIG. 2B

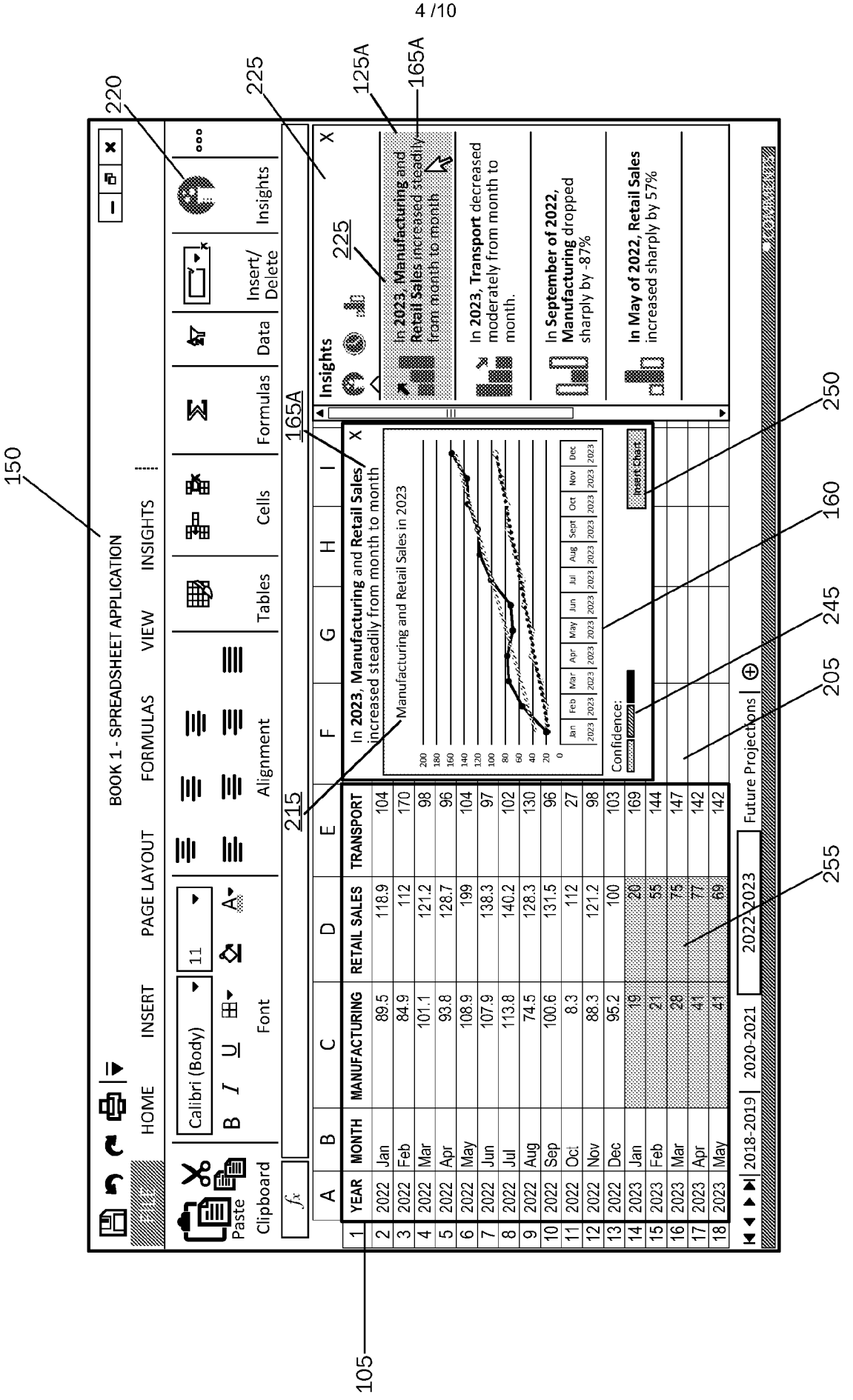
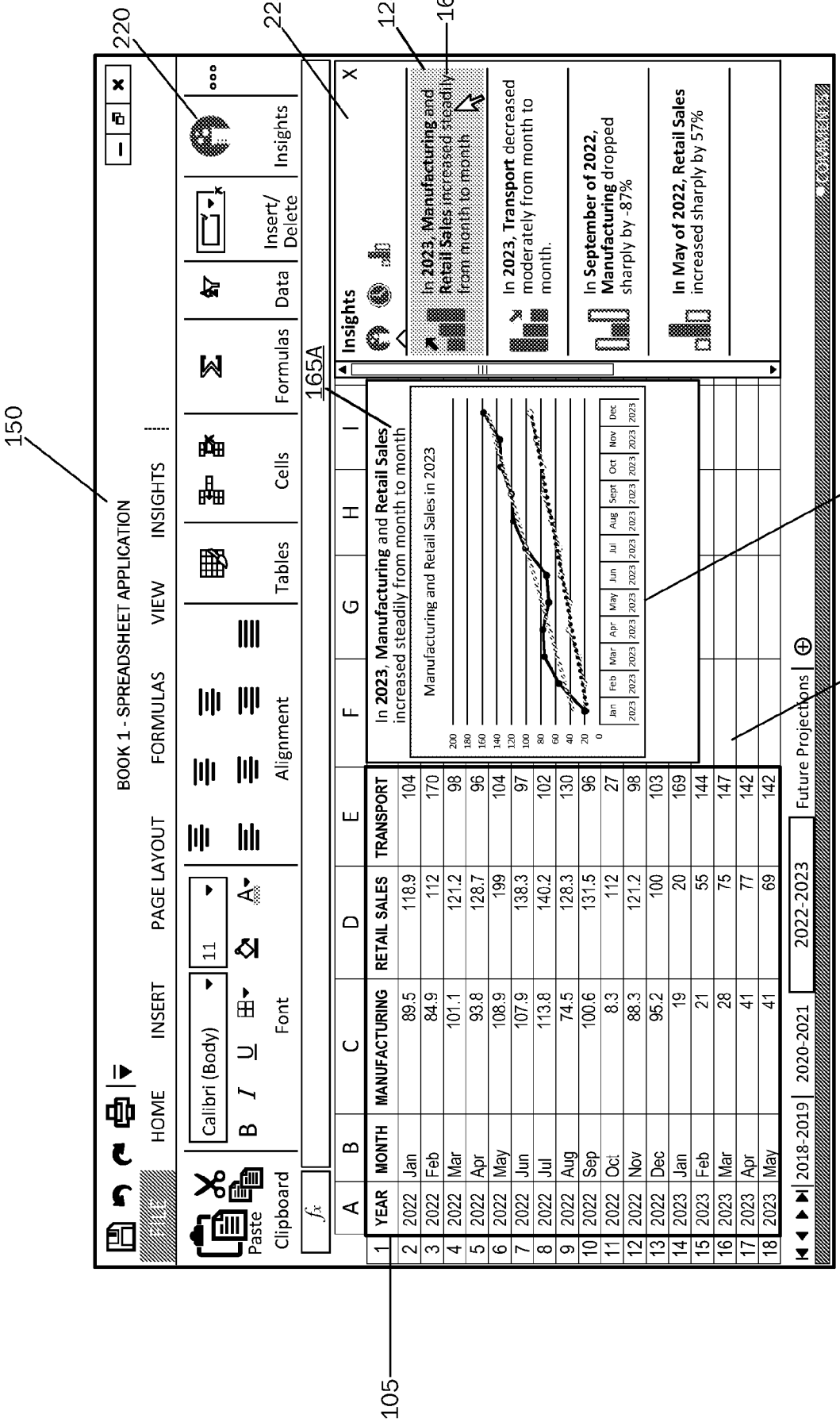

150
220
225
125A
165A
165A
215
105
250
160
245
205
255
BOOK 1 - SPREADSHEET APPLICATION
HOME
INSERT
PAGE LAYOUT
FORMULAS
VIEW
INSIGHTS
Insights
Insights
In 2023, Manufacturing and Retail Sales increased steadily from month to month
In 2023, Transport decreased moderately from month to month.
In September of 2022, Manufacturing dropped sharply by -87%
In May of 2022, Retail Sales increased sharply by 57%
In 2023, Manufacturing and Retail Sales increased steadily from month to month
Manufacturing and Retail Sales in 2023
Confidence:
Insert Chart
2018-2019
2020-2021
2022-2023
Future Projections

FIG. 2C



YEAR	MONTH	MANUFACTURING	RETAIL SALES	TRANSPORT
2022	Jan	89.5	118.9	104
2022	Feb	84.9	112	170
2022	Mar	101.1	121.2	98
2022	Apr	93.8	128.7	96
2022	May	108.9	199	104
2022	Jun	107.9	138.3	97
2022	Jul	113.8	140.2	102
2022	Aug	74.5	128.3	130
2022	Sep	100.6	131.5	96
2022	Oct	8.3	112	27
2022	Nov	88.3	121.2	98
2022	Dec	95.2	100	103
2023	Jan	19	20	169
2023	Feb	21	55	144
2023	Mar	28	75	147
2023	Apr	41	77	142
2023	May	41	69	142

FIG. 2D

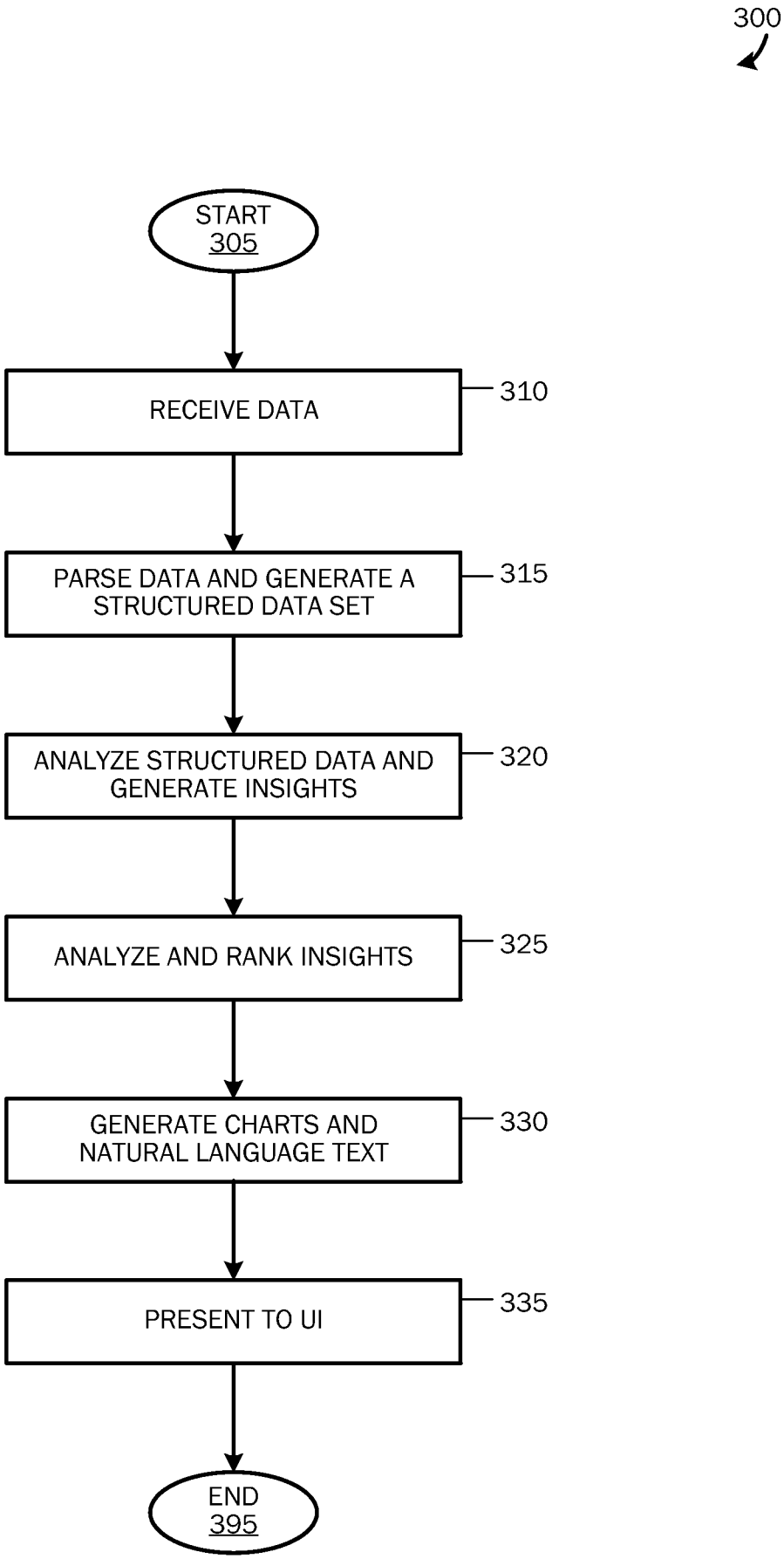

300
START
305
RECEIVE DATA
310
PARSE DATA AND GENERATE A STRUCTURED DATA SET
315
ANALYZE STRUCTURED DATA AND GENERATE INSIGHTS
320
ANALYZE AND RANK INSIGHTS
325
GENERATE CHARTS AND NATURAL LANGUAGE TEXT
330
PRESENT TO UI
335
END
395

FIG. 3

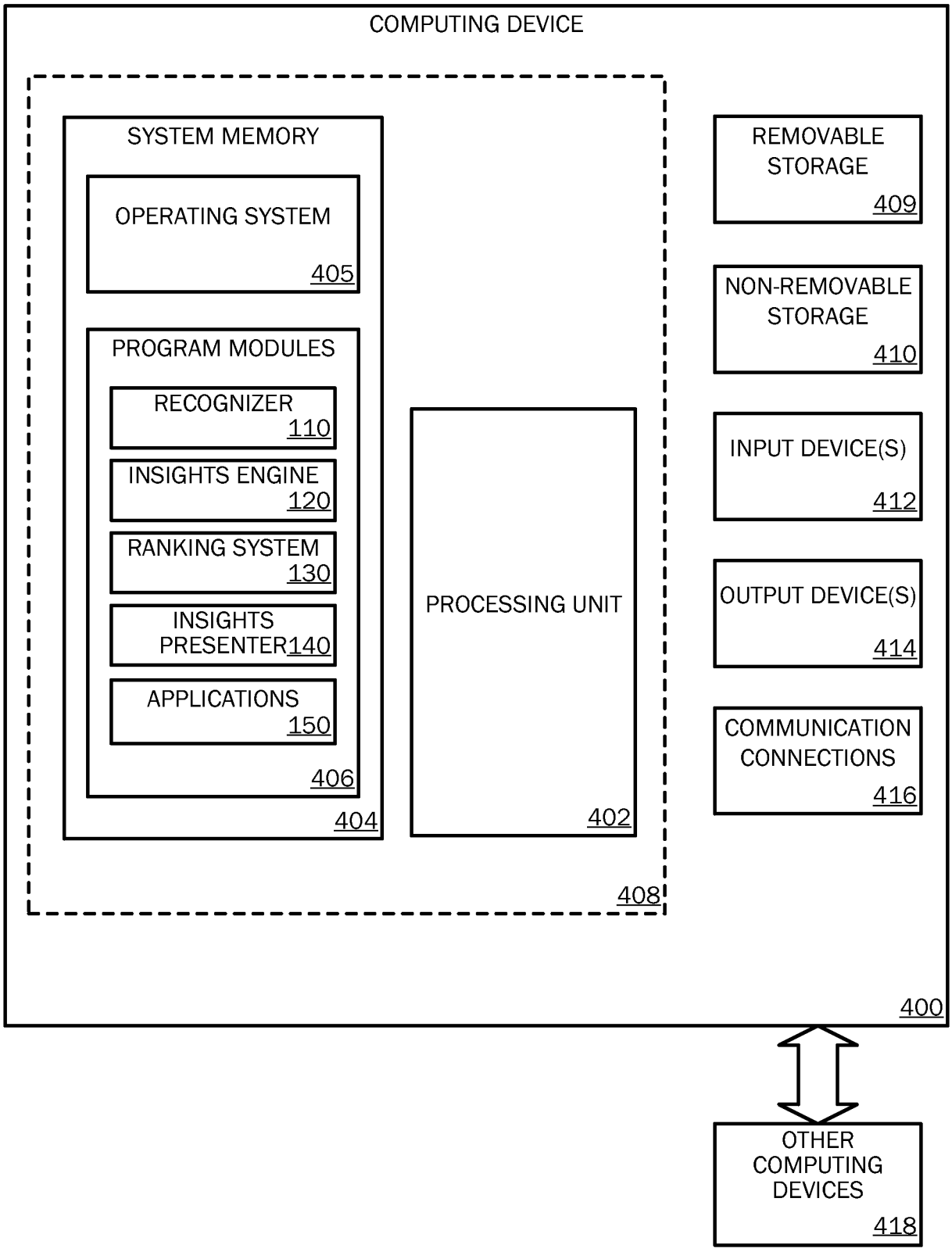

COMPUTING DEVICE
SYSTEM MEMORY
OPERATING SYSTEM
405
PROGRAM MODULES
RECOGNIZER
110
INSIGHTS ENGINE
120
RANKING SYSTEM
130
INSIGHTS PRESENTER
140
APPLICATIONS
150
406
404
PROCESSING UNIT
402
408
REMOVABLE STORAGE
409
NON-REMOVABLE STORAGE
410
INPUT DEVICE(S)
412
OUTPUT DEVICE(S)
414
COMMUNICATION CONNECTIONS
416
400
OTHER COMPUTING DEVICES
418

FIG. 4

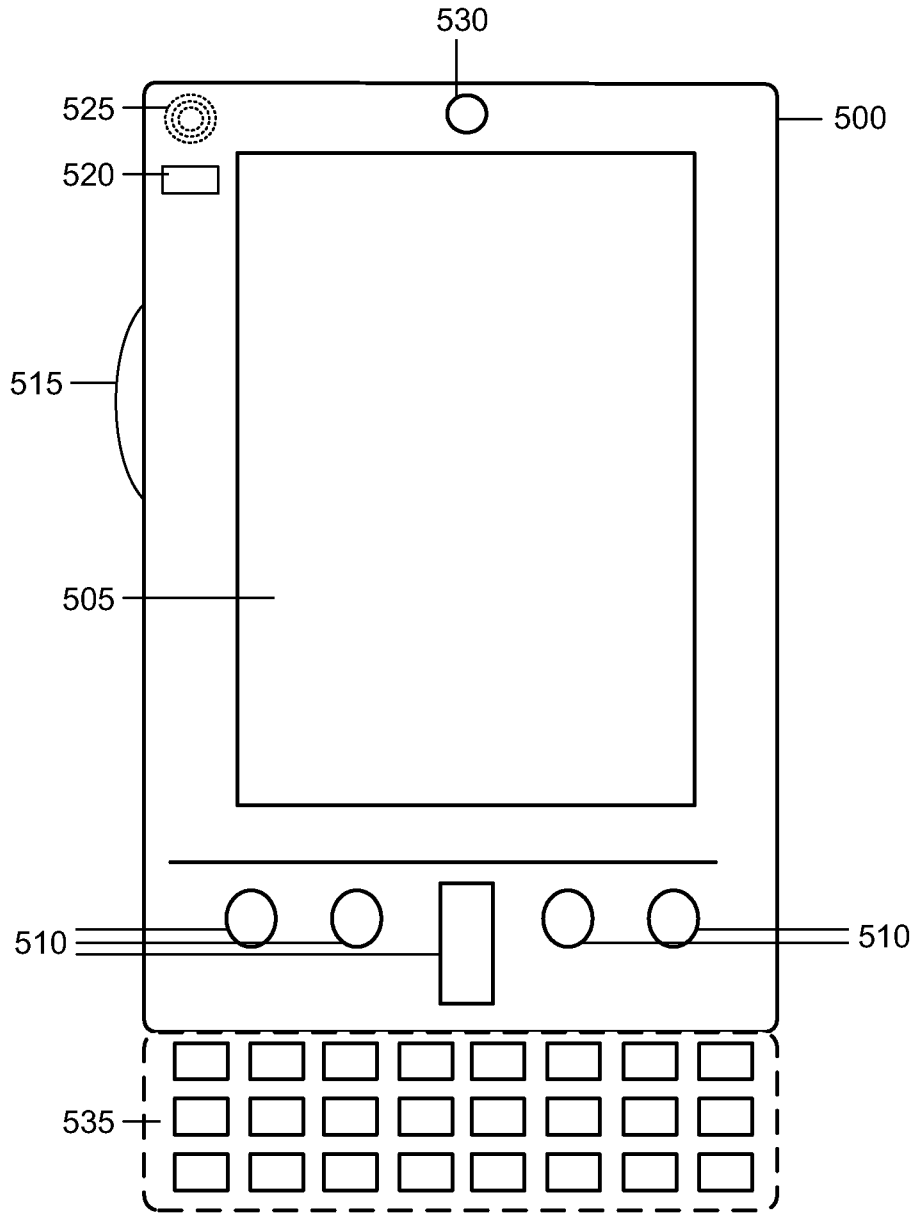


FIG. 5A

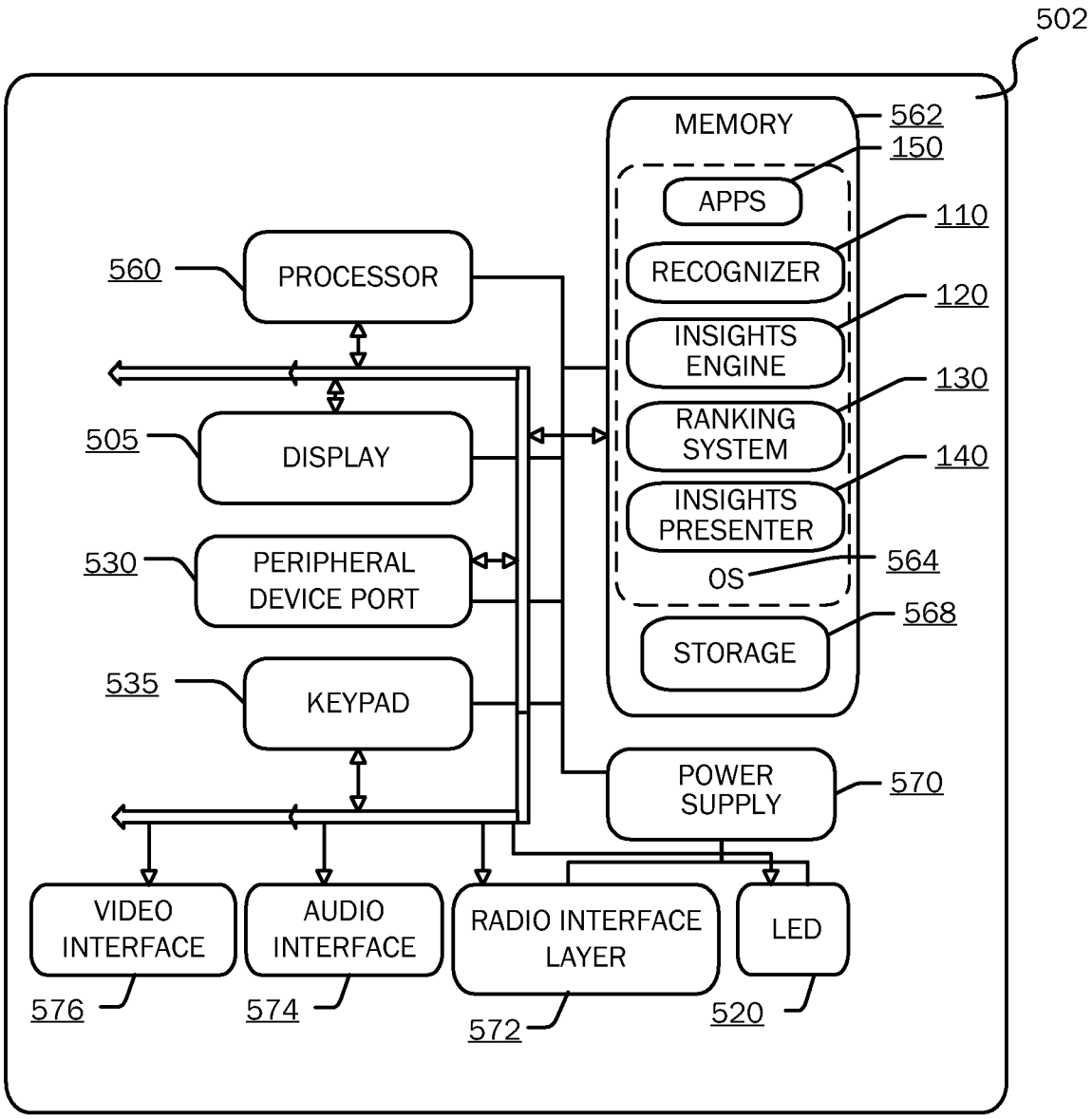

502
MEMORY
562
150
APPS
110
RECOGNIZER
120
INSIGHTS ENGINE
130
RANKING SYSTEM
140
INSIGHTS PRESENTER
564
OS
568
STORAGE
560
PROCESSOR
505
DISPLAY
530
PERIPHERAL DEVICE PORT
535
KEYPAD
POWER SUPPLY
570
VIDEO INTERFACE
576
AUDIO INTERFACE
574
RADIO INTERFACE LAYER
572
LED
520

FIG. 5B

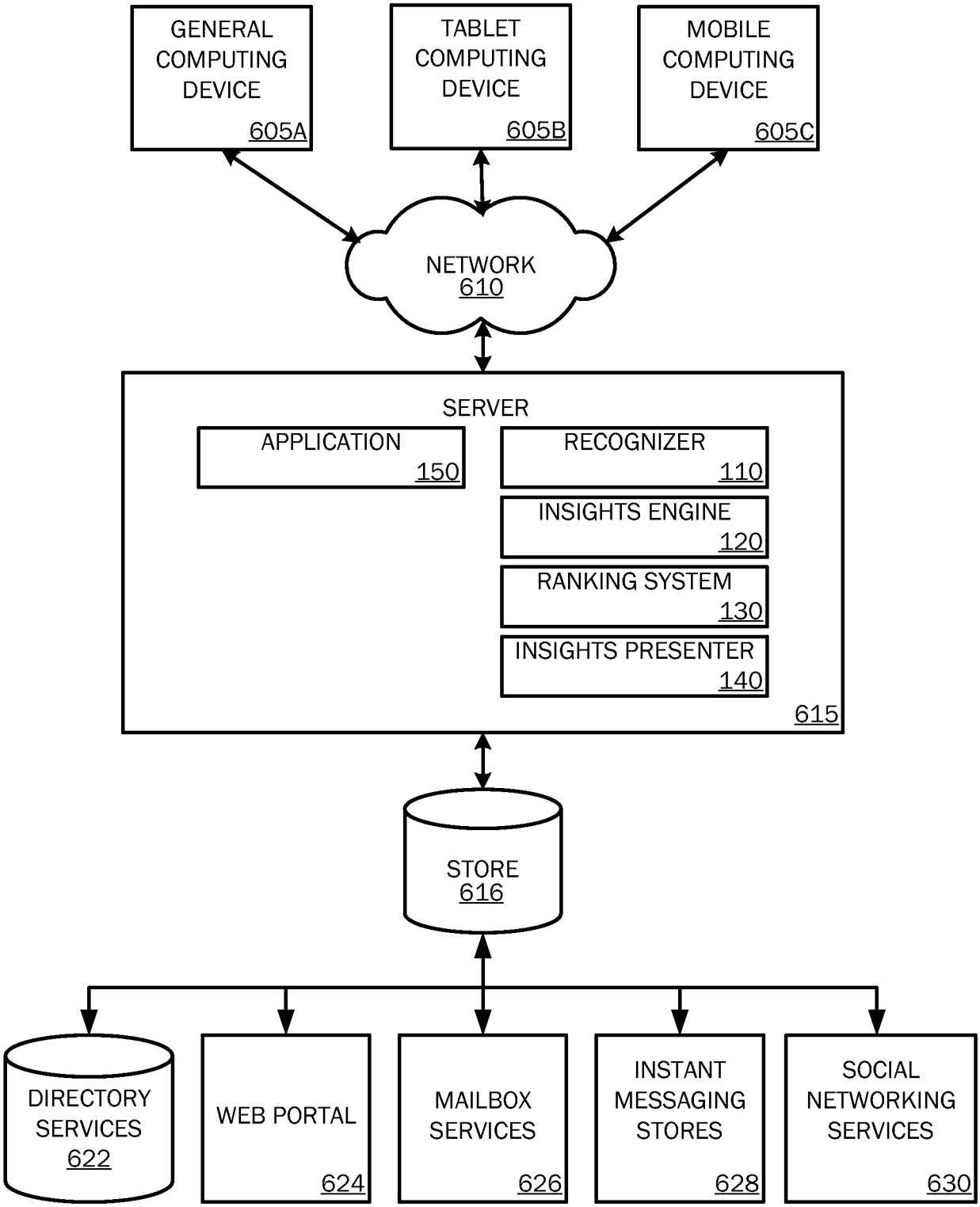

GENERAL COMPUTING DEVICE
605A
TABLET COMPUTING DEVICE
605B
MOBILE COMPUTING DEVICE
605C
NETWORK
610
SERVER
APPLICATION
150
RECOGNIZER
110
INSIGHTS ENGINE
120
RANKING SYSTEM
130
INSIGHTS PRESENTER
140
615
STORE
616
DIRECTORY SERVICES
622
WEB PORTAL
624
MAILBOX SERVICES
626
INSTANT MESSAGING STORES
628
SOCIAL NETWORKING SERVICES
630

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/071837

A. CLASSIFICATION OF SUBJECT MATTER

G06F 17/30 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F

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

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

CNKI, CNPAT, WPI, EPODOC, IEEE: MICROSOFT, SUNJim, LIUShusen, ZHANGDongmei, ZHANGHaidong, DANGYingnong, LIANGXiao, RUBLEScott, olap, insight?, sheet?, spreadsheet?, table?, structure?, semi-structured, analyz+, identif+, strength, type??, display+, present+, rank+, auto+, automat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 102981702 A (MICROSOFT CORP.) 20 March 2013 (2013-03-20) description, paragraphs [0013]-[0016], [0019]-[0054], figures 1-4	1-20
X	US 8365212 B1 (ORLOWSKI, ROBERT ALAN) 29 January 2013 (2013-01-29) abstract, claims 1-3	1-20
A	CN 102193940 A (SHANGHAI LONGCHEER TECHNOLOGY CO., LTD.) 21 September 2011 (2011-09-21) the whole document	1-20
A	CN 101556606 A (TONGFANG ZHIWANG BEIJING TECHNOLOGY CO., LTD.) 14 October 2009 (2009-10-14) the whole document	1-20
A	CN 102483776 A (LIFESCAN SCOTLAND LTD.) 30 May 2012 (2012-05-30) the whole document	1-20
A	WO 03010679 A1 (BLUE MARTINI SOFTWARE) 06 February 2003 (2003-02-06) the whole document	1-20

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

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Date of the actual completion of the international search	Date of mailing of the international search report
14 October 2014	**27 October 2014**
Name and mailing address of the ISA/CN **STATE INTELLECTUAL PROPERTY OFFICE OF THE P.R.CHINA(ISA/CN)** **6,Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088 China** Facsimile No. **(86-10)62019451**	Authorized officer **ZHANG,Wen** Telephone No. **(86-10)82245489**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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