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(54) Title: AUTOMATIC EXTRACTION OF COMMITMENTS AND REQUESTS FROM COMMUNICATIONS AND CONTENT

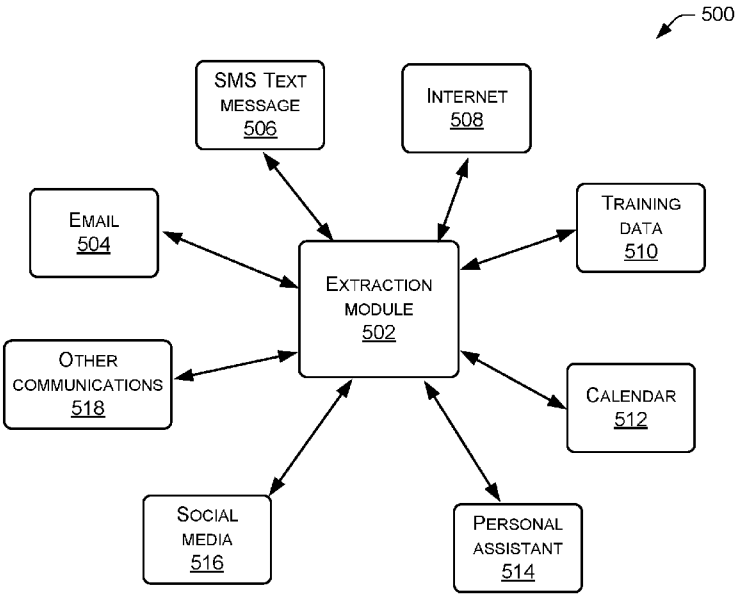

FIG. 5

(57) Abstract: A system that analyses content of electronic communications may automatically extract requests or commitments from the electronic communications. In one example process, a processing component may analyze the content to determine one or more meanings of the content; query content of one or more data sources that is related to the electronic communications; and based, at least in part, on (i) the one or more meanings of the content and (ii) the content of the one or more data sources, automatically identify and extract a request or commitment from the content. Multiple actions may follow from initial recognition and extraction, including confirmation and refinement of the description of the request or commitment, and actions that assist one or more of the senders, recipients, or others to track and address the request or commitment, including the creation of additional messages, reminders, appointments, or to-do lists.

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AUTOMATIC EXTRACTION OF COMMITMENTS AND REQUESTS FROM COMMUNICATIONS AND CONTENT

BACKGROUND

[0001] Electronic communications have become an important form of social and business interactions. Such electronic communications include email, calendars, SMS text messages, voice mail, images, videos, and other digital communications and content, just to name a few examples. Electronic communications are generated automatically or manually by users on any of a number of computing devices.

SUMMARY

[0002] This disclosure describes techniques and architectures for identifying requests and commitments in electronic communications, such as messages between or among users. For example, an email exchange between two people may include text from a first person sending a request to a second person to perform a task, and the second person responding with a message indicating a commitment to perform the task. The email exchange may convey enough information for the system to automatically determine the presence of the request to perform the task and/or the commitment by the recipient to perform the task, as well as to determine the identities of the person originating the request and the person or people responding with the commitment to perform or contribute to the completion of the task. If the email exchange does not convey enough information to determine the presence of the request and/or the commitment, the system may query other sources of information that may be related to one or more portions of the email exchange. For example, the system may examine a longer history of messages such as that contained in maintained "threads" of email, or may query a calendar or database of one or both of the authors of the email exchange for additional information. The system may also seek confirmation from one or more of the users involved in the communications about the existence of a potential request or of a commitment to perform a task given levels of uncertainty about either.

[0003] 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 or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter. The term "techniques," for instance, may refer to system(s), method(s), computer-readable instructions, module(s), algorithms, hardware logic (e.g., Field-programmable Gate Arrays

(FPGAs), Application-specific Integrated Circuits (ASICs), Application-specific Standard Products (ASSPs), System-on-a-chip systems (SOCs), Complex Programmable Logic Devices (CPLDs)), and/or other technique(s) as permitted by the context above and throughout the document.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same reference numbers in different figures indicate similar or identical items.

[0005] FIG. 1 is a block diagram depicting an example environment in which techniques described herein may be implemented.

[0006] FIG. 2 is a block diagram illustrating electronic communication subjected to an example task extraction process.

[0007] FIG. 3 is a block diagram illustrating an electronic communication that includes an example text thread and a task extraction process of a request and a commitment.

[0008] FIG. 4 is a table of example relations among messages, commitments and requests.

[0009] FIG. 5 is a block diagram of multiple information sources that may communicate with an example extraction module.

[0010] FIG. 6 is a block diagram of an example extraction module acting on non-text communication.

[0011] FIG. 7 is a block diagram of an example machine learning system.

[0012] FIG. 8 is a block diagram of example machine learning models.

[0013] FIG. 9 is a block diagram illustrating example online and offline processes for commitment and request extraction.

[0014] FIG. 10 is a flow diagram of an example task extraction process.

DETAILED DESCRIPTION

[0015] Various examples describe techniques and architectures for a system that performs, among other things, extraction of tasks from electronic communications, such as messages between or among one or more users (e.g., a single user may send a message to oneself or to one or more other users). For example, an email exchange between two people may include text from a first person sending a request to a second person to perform a task, and the second person making a commitment (e.g., agreeing) to perform the task. . The email exchange may convey enough information for the system to

automatically determine the presence of the request to perform the task and/or the commitment to perform the task. In some implementations, the email exchange does not convey enough information to determine the presence of the request and/or the commitment. Whether or not this is the case, the system may query other sources of information that may be related to one or more portions of the email exchange. For example, the system may examine other messages exchanged by one or both of the authors of the email exchange or by other people. The system may also examine larger corpora of email and other messages. Beyond other messages, the system may query a calendar or database of one or both of the authors of the email exchange for additional information. In some implementations, the system may query traffic or weather conditions at respective locations of one or both of the authors.

[0016] Herein, "extract" is used to describe determining a request or commitment in a communication. For example, a system may extract a request or commitment from a series of text messages. Here, the system is determining or identifying a request or commitment from the series of text messages, but is not necessarily removing the request or the commitment from the series of text messages. In other words, "extract" in the context used herein, unless otherwise described for particular examples, does not mean to "remove".

[0017] Herein, a process of extracting a request and/or commitment from a communication may be described as a process of extracting "task content". In other words, "task content" as described herein refers to one or more requests, one or more commitments, and/or projects comprising combinations of requests and commitments that are conveyed in the meaning of the communication. In various implementations, interplay between commitments and requests may be identified and extracted. Such interplay, for example, may be where a commitment to a requester generates one or more requests directed to the requester and/or third parties (e.g., individuals, groups, processing components, and so on. For example, a commitment to a request from an engineering manager to *complete a production yield analysis* may generate secondary requests directed to a manufacturing team for production data.

[0018] In various implementations, a process may extract a fragment of text containing a commitment or request. For example, a paragraph may include a commitment or request in the second sentence of the paragraph. Additionally, the process may extract the text fragment, sentence, or paragraph that contains the commitment or request, such as the third sentence or various word phrases in the paragraph.

[0019] In various implementations, a process may augment extracted task content (e.g., requests or commitments) with identification of people and one or more locations associated with the extracted task content. For example, an extracted request may be stored or processed with additional information, such as identification of the requester and/or "requestee(s)", pertinent location(s), times/dates, and so on.

[0020] Once identified and extracted by a computing system, task content (e.g., the proposal or affirmation of a commitment or request) of a communication may be further processed or analyzed to identify or infer semantics of the commitment or request including: identifying the primary owners of the request or commitment (e.g., if not the parties in the communication); the nature of the task content and its properties (e.g., its description or summarization); specified or inferred pertinent dates (e.g., deadlines for completing the commitment or request); relevant responses such as initial replies or follow-up messages and their expected timing (e.g., per expectations of courtesy or around efficient communications for task completion among people or per an organization); and information resources to be used to satisfy the request. Such information resources, for example, may provide information about time, people, locations, and so on. The identified task content and inferences about the task content may be used to drive automatic (e.g., computer generated) services such as reminders, revisions (e.g., and displays) of to-do lists, appointments, meeting requests, and other time management activities. In some examples, such automatic services may be applied during the composition of a message (e.g., typing an email or text), reading the message, or at other times, such as during offline processing of email on a server or client device. The initial extraction and inferences about a request or commitment may also invoke automated services that work with one or more participants to confirm or refine current understandings or inferences about the request or commitment and the status of the request or commitment based, at least in part, on the identification of missing information or of uncertainties about one or more properties detected or inferred from the communication.

[0021] In some examples, task content may be extracted from multiple forms of communications, including digital content capturing interpersonal communications (e.g., email, SMS text, instant messaging, phone calls, posts in social media, and so on) and composed content (e.g., email, note-taking and organizational tools such as OneNote® by Microsoft Corporation of Redmond, Washington, word-processing documents, and so on).

[0022] As described below, some example techniques for identifying and extracting task content from various forms of electronic communications may involve language analysis

of content of the electronic communications, which human annotators may annotate as containing commitments or requests. Human annotations may be used in a process of generating a corpus of training data that is used to build and to test automated extraction of commitments or requests and various properties about the commitments or requests. Techniques may also involve proxies for human-generated labels (e.g., based on email engagement data or relatively sophisticated extraction methods). For developing methods used in extraction systems or for real-time usage of methods for identifying and/or inferring tasks or commitments and their properties, analyses may include natural language processing (NLP) analyses at different points along a spectrum of sophistication. For example, an analysis having a relatively low-level of sophistication may involve identifying key words based on simple word breaking and stemming. An analysis having a relatively mid-level of sophistication may involve consideration of larger analyses of sets of words ("bag of words"). An analysis having a relatively high-level of sophistication may involve sophisticated parsing of sentences in communications into parse trees and logical forms. Techniques for identifying and extracting task content may involve identifying attributes or "features" of components of messages and sentences of the messages. Such techniques may employ such features in a training and testing paradigm to build a statistical model to classify components of the message. For example, such components may comprise sentences or the overall message as containing a request and/or commitment and also identify and/or summarize the text that best describes the request and/or commitment.

[0023] In some examples, techniques for extraction may involve a hierarchy of analysis, including using a sentence-centric approach, consideration of multiple sentences in a message, and global analyses of relatively long communication threads. In some implementations, such relatively long communication threads may include sets of messages over a period of time, and sets of threads and longer-term communications (e.g., spanning days, weeks, months, or years). Multiple sources of content associated with particular communications may be considered. Such sources may include histories and/or relationships of/among people associated with the particular communications, locations of the people during a period of time, calendar information of the people, and multiple aspects of organizations and details of organizational structure associated with the people.

[0024] In some examples, techniques may directly consider requests or commitments identified from components of content as representative of the requests or commitments, or may be further summarized. Techniques may extract other information from a sentence

or larger message, including relevant dates (e.g., deadlines on which requests or commitments are due), locations, urgency, time-requirements, task subject matter (e.g., a project), and people. In some implementations, a property of extracted task content is determined by attributing commitments and/or requests to particular authors of a message. This may be particularly useful in the case of multi-party emails with multiple recipients, for example.

[0025] Beyond text of a message, techniques may consider other information for extraction and summarization, such as images and other graphical content, the structure of the message, the subject header, length of the message, position of a sentence or phrase in the message, date/time the message was sent, and information on the sender and recipients of the message, just to name a few examples. Techniques may also consider features of the message itself (e.g., the number of recipients, number of replies, overall length, and so on) and the context (e.g., day of week). In some implementations, a technique may further refine or prioritize initial analyses of candidate messages/content or resulting extractions based, at least in part, on the sender or recipient(s) and histories of communication and/or of the structure of the organization.

[0026] In some examples, techniques may include analyzing features of various communications beyond a current communication (e.g., email, text, and so on). For example, techniques may consider interactions between or among commitments and requests, such as whether an early portion of a communication thread contains a commitment or request, the number of commitments and/or requests previously made between two (or more) users of the communication thread, and so on.

[0027] In some examples, techniques may include analyzing features of various communications that include conditional task content commitments or requests. For example, a conditional commitment may be "If I see him, I'll let him know." A conditional request may be "If the weather is clear tomorrow, please paint the house."

[0028] In some examples, techniques may include augmenting extracted task content (e.g., commitments and/or requests) with additional information such as deadlines, identification (e.g., names, ID number, and so on) of people associated with the task content, and places that are mentioned in the task content.

[0029] In some examples, a computing system may construct predictive models for identifying and extracting requests and commitments and related information using machine learning procedures that operate on training sets of annotated corpora of sentences or messages (e.g., machine learning features). In other examples, a computing

system may use relatively simple rule-based approaches to perform extractions and summarization.

[0030] In some examples, a computing system may explicitly notate task content extracted from a message in the message itself. In various implementations, a computing system may flag messages containing requests and commitments in multiple electronic services and experiences, which may include products or services such as revealed via products and services provided by Windows®, Cortana®, Outlook®, Outlook Web App® (OWA), Xbox®, Skype®, Lync® and Band®, all by Microsoft Corporation, and other such services and experiences from others. In various implementations, a computing system may extract requests and commitments from audio feeds, such as from phone calls or voicemail messages, SMS images, instant messaging streams, and verbal requests to digital personal assistants, just to name a few examples.

[0031] In some examples, a computing system may learn to improve predictive models and summarization used for extracting task content by implicit and explicit feedback by users. For example, such feedback may include user input (e.g., in response to displayed extracted task content) about whether extracted content is correct or incorrect. Such feedback may be quantified and/or stored by the computer system and subsequently applied to predictive models, for example.

[0032] Various examples are described further with reference to FIGS. 1-10.

[0033] The environment described below constitutes but one example and is not intended to limit the claims to any one particular operating environment. Other environments may be used without departing from the spirit and scope of the claimed subject matter.

[0034] FIG. 1 illustrates an example environment 100 in which example processes involving task extraction as described herein can operate. In some examples, the various devices and/or components of environment 100 include a variety of computing devices 102. By way of example and not limitation, computing devices 102 may include devices 102a-102e. Although illustrated as a diverse variety of device types, computing devices 102 can be other device types and are not limited to the illustrated device types. Computing devices 102 can comprise any type of device with one or multiple processors 104 operably connected to an input/output interface 106 and computer-readable media 108, e.g., via a bus 110. Computing devices 102 can include personal computers such as, for example, desktop computers 102a, laptop computers 102b, tablet computers 102c, telecommunication devices 102d, personal digital assistants (PDAs) 102e, electronic book

readers, wearable computers (e.g., smart watches, personal health tracking accessories, etc.), automotive computers, gaming devices, etc. Computing devices 102 can also include, for example, server computers, thin clients, terminals, and/or work stations. In some examples, computing devices 102 can include components for integration in a computing device, appliances, or other sorts of devices.

[0035] In some examples, some or all of the functionality described as being performed by computing devices 102 may be implemented by one or more remote peer computing devices, a remote server or servers, or distributed computing resources, e.g., via cloud computing. In some examples, a computing device 102 may comprise an input port to receive electronic communications. Computing device 102 may further comprise one or multiple processors 104 to access various sources of information related to or associated with particular electronic communications. Such sources may include electronic calendars and databases of histories or personal information about authors of messages included in the electronic communications, just to name a few examples. In some implementations, an author has to "opt-in" or take other affirmative action before any of the multiple processors 104 can access personal information of the author. In some examples, one or multiple processors 104 may be configured to extract task content from electronic communications. One or multiple processors 104 may be hardware processors or software processors. As used herein, a processing unit designates a hardware processor.

[0036] In some examples, as shown regarding device 102d, computer-readable media 108 can store instructions executable by the processor(s) 104 including an operating system (OS) 112, a machine learning module 114, an extraction module 116 and programs or applications 118 that are loadable and executable by processor(s) 104. The one or more processors 104 may include one or more central processing units (CPUs), graphics processing units (GPUs), video buffer processors, and so on. In some implementations, machine learning module 114 comprises executable code stored in computer-readable media 108 and is executable by processor(s) 104 to collect information, locally or remotely by computing device 102, via input/output 106. The information may be associated with one or more of applications 118. Machine learning module 114 may selectively apply any of a number of machine learning decision models stored in computer-readable media 108 (or, more particularly, stored in machine learning 114) to apply to input data.

[0037] In some implementations, extraction module 116 comprises executable code stored in computer-readable media 108 and is executable by processor(s) 104 to collect

information, locally or remotely by computing device 102, via input/output 106. The information may be associated with one or more of applications 118. Extraction module 116 may selectively apply any of a number of statistical models or predictive models (e.g., via machine learning module 114) stored in computer-readable media 108 to apply to input data.

[0038] Though certain modules have been described as performing various operations, the modules are merely examples and the same or similar functionality may be performed by a greater or lesser number of modules. Moreover, the functions performed by the modules depicted need not necessarily be performed locally by a single device. Rather, some operations could be performed by a remote device (e.g., peer, server, cloud, etc.).

[0039] Alternatively, or in addition, some or all of the functionality described herein can be performed, at least in part, by one or more hardware logic components. For example, and without limitation, illustrative types of hardware logic components that can be used include Field-programmable Gate Arrays (FPGAs), Program-specific Integrated Circuits (ASICs), Program-specific Standard Products (ASSPs), System-on-a-chip systems (SOCs), Complex Programmable Logic Devices (CPLDs), etc.

[0040] In some examples, computing device 102 can be associated with a camera capable of capturing images and/or video and/or a microphone capable of capturing audio. For example, input/output module 106 can incorporate such a camera and/or microphone. Images of objects or of text, for example, may be converted to text that corresponds to the content and/or meaning of the images and analyzed for task content. Audio of speech may be converted to text and analyzed for task content.

[0041] Computer readable media includes computer storage media and/or communication media. Computer storage media includes volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules, or other data. Computer storage media includes, but is not limited to, phase change memory (PRAM), static random-access memory (SRAM), dynamic random-access memory (DRAM), other types of random-access memory (RAM), read-only memory (ROM), electrically erasable programmable read-only memory (EEPROM), flash memory or other memory technology, compact disk read-only memory (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 non-transmission medium that can be used to store information for access by a computing device.

[0042] In contrast, communication media embodies computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave, or other transmission mechanism. As defined herein, computer storage media does not include communication media. In various examples, memory 108 is an example of computer storage media storing computer-executable instructions. When executed by processor(s) 104, the computer-executable instructions configure the processor(s) to, among other things, analyze content of an individual electronic message, where the electronic message is (i) received among the electronic communications, (ii) entered by a user via a user interface, or (iii) retrieved from memory; and based, at least in part, on the analyzing the content, extract, from the electronic message, text corresponding to a request or to a commitment.

[0043] In various examples, an input device of or connected to input/output (I/O) interfaces 106 may be a direct-touch input device (e.g., a touch screen), an indirect-touch device (e.g., a touch pad), an indirect input device (e.g., a mouse, keyboard, a camera or camera array, etc.), or another type of non-tactile device, such as an audio input device.

[0044] Computing device(s) 102 may also include one or more input/output (I/O) interfaces 106, which may comprise one or more communications interfaces to enable wired or wireless communications between computing device 102 and other networked computing devices involved in extracting task content, or other computing devices, over network 111. Such communications interfaces may include one or more transceiver devices, e.g., network interface controllers (NICs) such as Ethernet NICs or other types of transceiver devices, to send and receive communications over a network. Processor 104 (e.g., a processing unit) may exchange data through the respective communications interfaces. In some examples, a communications interface may be a PCIe transceiver, and network 111 may be a PCIe bus. In some examples, the communications interface may include, but is not limited to, a transceiver for cellular (3G, 4G, or other), WI-FI, Ultra-wideband (UWB), BLUETOOTH, or satellite transmissions. The communications interface may include a wired I/O interface, such as an Ethernet interface, a serial interface, a Universal Serial Bus (USB) interface, an INFINIBAND interface, or other wired interfaces. For simplicity, these and other components are omitted from the illustrated computing device 102. Input/output (I/O) interfaces 106 may allow a device 102 to communicate with other devices such as user input peripheral devices (e.g., a keyboard, a mouse, a pen, a game controller, a voice input device, a touch input device, gestural input

device, and the like) and/or output peripheral devices (e.g., a display, a printer, audio speakers, a haptic output, and the like).

[0045] FIG. 2 is a block diagram illustrating electronic communication 202 subjected to an example task extraction process 204. For example, process 204 may involve any of a number of techniques for detecting whether a commitment 206 or request 208 has been made in incoming or outgoing communications. Process 204 may also involve techniques for automatically marking, annotating, or otherwise identifying the message as containing a commitment or request. In some examples, process 204 may include techniques that extract a summary (not illustrated) of commitments or requests for presentation and follow-up tracking and analysis. Commitments 206 or requests 208 may be extracted from multiple forms of content of electronic communication 202. Such content may include interpersonal communications such as email, SMS text or images, instant messaging, posts in social media, meeting notes, and so on. Such content may also include content composed using email applications or word-processing applications, among other possibilities.

[0046] In some examples, task extraction process 204 may extract task content regarding third parties. For example, electronic communication 202, such as an email, may include a commitment by a first person answering the email. This commitment may be a first-person commitment. This commitment may, however, be a third-person commitment, which is a commitment by the first person (answering the email) on behalf of another person. For example, the first person may be a supervisor establishing a commitment to a vice president for a subordinate to perform a task. For a particular example, a third-person commitment may be "*My assistant John will get a report to you later today.*"

[0047] In some examples, task extraction process 204 may extract task content from electronic communication 202, such as a message, based at least in part on personal and/or professional relationships between or among authors of the message (e.g., such as an email thread) or people associated with content of the message (e.g., such as people mentioned in the message). Task extraction process 204 may also extract task content from a message based, at least in part, on previous communications between or among authors of the message or people associated with content of the message.

[0048] In some examples, task extraction process 204 may (i) analyze content of electronic communication 202 and (ii) automatically extract a request or a commitment from the content of the electronic communication in real time. For example, during task

extraction process 204, a system performing the task extraction process may immediately ask for confirmation about a commitment and/or provide real-time support to a user by notifying the user of possible time conflicts or other commitments to prevent the user from overpromising. In a particular example, the system may serve to assist with time management and inform the user about being overloaded by displaying the message "*You probably can't do this, you've already committed to too many things this week.*"

[0049] FIG. 3 is a block diagram illustrating an electronic communication 302 that includes an example text thread and a task extraction process 304 of a request or a commitment. For example, communication 302, which may be a text message to a user received on a computing device of the user from another user, includes text 306 from the other user and text 308 from the user. Task extraction process 304 includes analyzing content (e.g., text 306 and text 308) of communication 302 and determining (i) a commitment of the user or the other user and/or (ii) a request by the user or the other user. In the example illustrated in FIG. 3, text 306 by the other user includes a request 310 that the user *help set up Alexis' birthday party on May 9th*. Text 308 by the user includes a commitment 312 that the user intends to *help set up Alexis' birthday party on May 9th, by 3pm*. Task extraction process 304 may determine the request and commitment by any of a number of techniques involving analyzing text 306 and text 308. In some implementations, if the text is insufficient for determining a request or commitment (e.g., "missing" information or highly uncertain information), then task extraction process 304 may query any of a number of data sources. For example, if text 306 did not include the date of Alexis' birthday party (e.g., the other user may assume that the user remembers the date), then task extraction process 304 may query a calendar of the user or the other user for the birthday date.

[0050] In various examples, task extraction process 304 may determine likelihood (e.g., an inferred probability) or other measure of confidence that an incoming or outgoing message (e.g., email, text, etc.) contains a request or commitment intended for/by the recipient/sender. Such confidence or likelihood may be determined, at least in part, from calculated probabilities that one or more components of the message, or summarizations of the components, are valid requests or commitments.

[0051] In some examples, task extraction process 304 may determine a measure of confidence of a commitment, where a low-confidence commitment is one for which the user is not likely to fulfill the commitment and a high-confidence commitment is one for which the user is highly likely to fulfill the commitment. Likelihood (e.g., probability) or

other measures of confidence may be used to capture how certain task extraction process 304 is regarding an extracted commitment based, at least in part, on use of a statistical classifier, for example. Confidence of a commitment may be useful for subsequent services such as reminders, revisions of to-do lists, appointments, meeting requests, and other time management activities. Determining confidence of a commitment may be based, at least in part, on history of events of the user (e.g., follow-through of past commitments, and so on) and/or history of events of the other user and/or personal information (e.g., age, sex, age, occupation, frequent traveler, and so on) of the user or other user. For example, task extraction process 304 may query such histories. In some implementations, either or all of the users have to "opt-in" or take other affirmative action before task extraction process 304 may query personal information of the users. Task extraction process 304 may assign a relatively high confidence for a commitment by the user if such histories demonstrate that the user, for example, has attended the last several of Alexis' birthdays, tends to attend many other people's birthdays, has a relatively close relationship to Alexis and/or the other user, and so on. Determining confidence of a commitment may also be based, at least in part, on key words or terms in text 306 and/or text 308. For example, "birthday party" generally has positive and desirable implications (e.g., a party, in contrast to a work task), so that a commitment may be relatively strong. On the other hand, in another example that involves a commitment to writing an accounting report, such an activity is generally undesirable, and such a commitment may thus be assigned a relatively low confidence. If such a commitment to writing an accounting report is associated with a job (e.g., occupation) of the user, however, then such a commitment may be assigned a relatively high confidence. Task extraction process 304 may weigh a number of such scenarios and factors to determine the confidence of a commitment. For example, task extraction process 304 may determine confidence (e.g., importance) of a request or a commitment in a message based, at least in part, on content related to the electronic message.

[0052] FIG. 4 is a table 400 of example relations among messages and task content. In particular, such task content includes commitments and/or requests, either of which may be generated (e.g., automatically by an application or manually written) by a user of a computing device or "other user entity", which may be one or more people on one or more computing devices. In some examples, the other user entity may be the user, who may send a message to him or herself. In other examples, the user and/or the other user entity may be any person (e.g., a delegate, an assistant, a supervisor, etc.) or a machine (e.g., a

processor-based system configured to receive and perform instructions). Table 400 illustrates outgoing messages that are generated by the user of the computing device and transmitted to the other user entity, and incoming messages that are generated by the other user entity and received by the user of the computing device.

[0053] Examples of commitments that may be extracted from outgoing or incoming messages include: "I will prepare the documents and send them to you on Monday." "I will send Mr. Smith the check by end of day Friday." "I'll do it." "I'll get back to you." "Will do." And so on. The latter examples demonstrate that a commitment (or statement thereof) need not include a time or deadline. Examples of requests that may be extracted from incoming or outgoing messages include: "Can you make sure to leave the key under the mat?" "Let me know if you can make it earlier for dinner." "Can you get the budget analysis done by end of month?" And so on. A request need not be in the form of a direct question. For example, "*Don't forget to get your report in by 5pm*" is not a direct question, yet this statement poses a request.

[0054] Table 400 includes four particular cases of tasks included in messages. One case is an outgoing message that includes a commitment to the other user entity by the user. Another case is an outgoing message that includes a request to the other user entity by the user. Yet another case is an incoming message that includes a commitment to the user from the other user entity. Still another case is an incoming message that includes a request from the other user entity to the user. Processes for extracting task content from the messages may differ from one another depending, at least in part, on which of the particular cases is being processed. Such processes may be performed by the computing device of the user or a computing system (e.g., server) in communication with the computing device. For example, a process applied to the case where an incoming message includes a commitment to the user from the other user entity may involve querying various data sources to determine confidence (e.g., sincerity, reliability, worthiness) of the commitment of the other user entity. Such various data sources may include personal data or history of the other user entity. In some examples, data sources may be memory associated with a processing component of a device, such as a memory device electronically coupled to a processor via a bus. In some examples, history of actions (cancelling meetings or failing to follow-through with tasks) by the other user entity may be indicative of the reliability of the commitment of the other user entity. In some implementations, the user and/or the other user entity has to "opt-in" or take other

affirmative action before processes can access personal information of the user and/or the other user entity.

[0055] As another example, a process applied to the case where an outgoing message includes a request to the other user entity by the user may involve querying various data sources to determine likelihood of outcome of the other user entity responding with a strong (e.g., sincere, reliable, worthy) commitment to the request of the user. Such various data sources (which need not be external to the device(s) performing the process) may include personal data or history of the other user entity. For example, history of actions (cancelling meetings or failing to follow-through with tasks) by the other user entity may be indicative of the likelihood (or lack thereof) that the other user entity will accept or follow-through with a commitment to the request of the user.

[0056] On the other hand, a process applied to the case where an incoming message includes a request from the other user entity to the user may involve querying various data sources to determine importance of the request (and concomitantly, importance of a commitment to the request). For example, if the other user entity is a supervisor of the user then the request is likely to be relatively important. Accordingly, the process may query various data sources that include personal and/or professional data of the other user entity to determine is the other user entity is a supervisor, subordinate, co-worker, friend, family, and so on.

[0057] In another example, a process applied to the case where an outgoing message includes a commitment to the other user entity by the user may involve querying various data sources to determine importance of the commitment. For example, if the other user entity is a supervisor of the user then the commitment is likely to be relatively important. Accordingly, the process may query various data sources that include personal and/or professional data of the other user entity to determine is the other user entity is a supervisor, subordinate, co-worker, friend, family, and so on.

[0058] FIG. 5 is a block diagram of an example system 500 that includes an extraction module 502 in communication with a number of entities 504-518. Such entities may include host applications (e.g., Internet browsers, SMS text editors, email applications, electronic calendar functions, and so on), databases or information sources (e.g., personal histories of individuals, organizational information of businesses or agencies, third party data aggregators that might provide data as a service, and so on), just to name a few examples. Extraction module 502 may be the same as of similar to extraction module 116 in computing device 102, illustrated in FIG. 1, for example. Some of the entities 504-518,

such as (just to name a few) training data 510, calendar 512, and data collected from social media 516 may be stored in a memory device associated with extraction module 502. For example, the memory device may be directly connected (e.g., wired) to extraction module 502 (e.g., which may be a processing component). In another example, the memory device may be wirelessly and/or remotely connected (e.g., by one or more remote peer computing devices, a remote server or servers, or distributed computing resources, e.g., via cloud computing) to extraction module 502.

[0059] Extraction module 502 may be configured to analyze content of communications, and/or data or information provided by entities 504-518 by applying any of a number of language analysis techniques. For example, extraction module 502 may be configured to analyze content of communications provided by email entity 504, SMS text message entity 506, and so on. Extraction module 502 may also be configured to analyze data or information provided by Internet entity 508, a machine learning entity providing training data 510, email entity 504, calendar entity 512, and so on. Extraction module 502 may analyze content by applying language analysis to information or data collected from any of entities 504-518.

[0060] Double-ended arrows in FIG. 5 indicate that data or information may flow in either direction among entities 504-518 and extraction module 502. For example, data or information flowing from extraction module 502 to any of entities 504-518 may be part of a query generated by the extraction module to query the entities. Such a query may be used by extraction module 502 to determine one or more meanings of content provided by any of the entities.

[0061] In some examples, extraction module 502 may receive content of an email exchange (e.g., a communication) among a number of users from email entity 504. The extraction module may analyze the content to determine one or more meanings of the content. Analyzing content may be performed by any of a number of techniques to determine meanings of elements of the content, such as words, phrases, sentences, metadata (e.g., size of emails, date created, and so on), images, and how and if such elements are interrelated, for example. "Meaning" of content may be how one would interpret the content in a natural language. For example, the meaning of content may include a request for a person to perform a task. In another example, the meaning of content may include a description of the task, a time by when the task should be completed, background information about the task, and so on.

[0062] In an optional implementation, the extraction module may query content of one or more data sources, such as social media entity 516, for example. Such content of the one or more data sources may be related (e.g., related by subject, authors, dates, times, locations, and so on) to the content of the email exchange. Based, at least in part, on (i) the one or more meanings of the content of the email exchange and (ii) the content of the one or more data sources, extraction module 502 may automatically extract a request or commitment from the content of the email exchange.

[0063] In some examples, extraction module 502 may extract task content using predictive models learned from training data 510 and/or from real-time ongoing communications among the extraction module and any of entities 504-518. Such predictive models may infer that an outgoing or incoming communication (e.g., message) or contents of the communication contain a request. Similarly, an outgoing or incoming communication or contents of the communication may contain commitments to perform tasks. The identification and extraction of commitments and requests from incoming or outgoing communications may serve multiple functions that support the senders and receivers of the communications about commitments and requests.

[0064] In some examples, extraction module 502 may extract task content using statistical models to identify and extract the proposing and affirming of commitments and requests from email received from email entity 504 or SMS text messages from SMS text message entity 506, just to name a few examples. Statistical models may be based, at least in part, on data or information from any or a combination of entities 504-518.

[0065] In some examples, extraction module 502 may extract task content while the author of a message writes the message. For example, such writing may comprise typing an email or text message using any type of text editor or application. In other examples, extraction module 502 may extract task content while a person reads a received message. For example, as the person reads a message, extraction module 502 may annotate portions of the message by highlighting or emphasizing requests or commitments in the text of the message. In some implementations, the extraction module may add relevant information to the message during the reading (or display) of the message. For example, such relevant information may be inferred from additional sources of data or information, such as from entities 504-518. In a particular example, a computer system may display a message that includes a request for the reader to attend a type of class. Extraction module 502 may query Internet 508 to determine that a number of such classes are offered in various locations and at various times of day in an area where the reader resides (e.g., which may

be inferred from personal data regarding the reader). Accordingly, the extraction module may generate and provide a list of choices or suggestions to the reader. Such a list may be displayed near text of pertinent portions of the text in response to mouse-over, or may be "permanently" displayed in other portions of the display, for example. In some implementations, the list may include items that are selectable (e.g., by a mouse click) by the reader so that the request will include a time selected by the reader (this time may replace a time "suggested" by the requester and the requester may be automatically notified of the time selected by the reader).

[0066] FIG. 6 is a block diagram of an example extraction module 602 that may perform task extraction on non-text content 604, such as audio recordings, images, or video recording. Extraction module 602 may be the same as or similar to extraction module 502 illustrated in FIG. 5. For example, extraction module 602 may be in communication with any or all of entities 504-518.

[0067] Non-text content 604 may be translated into corresponding text 606 that describes elements of non-text content. For example, any of a number of image recognition techniques may be used to translate images (or stills of video recordings) to text. Similarly, any of a number of audio-to-text techniques may be used to translate audio recordings to text. Corresponding text 606 may be provided to extraction module 602, which may subsequently extract task content from the corresponding text. Such extracted task content may include commitments 608 and/or requests 610, for example.

[0068] A particular illustrative example that demonstrates how extraction module 602 may extract task content from non-text content 604 involves a message including an image of balloons and streamers. Such an image may be translated to text 606 by an image recognition technique that recognizes the image of balloons and streamers and generates text "balloon" and "streamers". Additional text may be included to describe the juxtapositional relationship among the balloons and streamers in the image. Extraction module 602 may query any of a number of entities (e.g., 504-518) to determine context of balloons and streamers relative to the sender of the message. In one example, extraction module 602 may determine (e.g., by searching for a match between the sender and an Internet site) that the message is an advertisement for party supplies. As a consequence, the extraction module may conclude that the message does not include a commitment or request. In another example, extraction module 602 may determine (e.g., by searching for personal information about the sender and the message receiver) that the message is a notice about a birthday party (e.g., such as if the sender or any family members have a

birthday coming soon, or the receiver has attended such a birthday in past years, and so on). In such a case, extraction module 602 may consider the image to be a request for the receiver to attend a birthday party. The extraction module may additionally infer the date of the party and thus generate a complete request that includes a task and time to perform the task.

[0069] In some examples, a task extraction process performed by extraction module 602 (or 502) may engage a message sender and/or receiver to confirm correctness of commitments or requests extracted by the extraction module. In particular, if extraction module 602 performs an inference with relatively low confidence (e.g., an inference based on nebulous or loosely interrelated information), then the extraction module may prompt a sender and/or receiver for additional information or confirmation regarding tasks in a message. On the other hand, if extraction module 602 performs an inference with relatively high confidence (e.g., an inference based on solid or tightly interrelated information), then the extraction module need not prompt a sender and/or receiver for additional information or confirmation regarding tasks in a message.

[0070] In some examples, extraction module 602 may be configured to perform translation of non-text content to corresponding text. In other examples, extraction module 602 may be configured to merely receive corresponding text that has already been translated from non-text content.

[0071] FIG. 7 is a block diagram of a machine learning system 700, according to various examples. Machine learning system 700 includes a machine learning model 702 (which may be similar to or the same as machine learning module 114, illustrated in FIG. 1), a training module 704, and an extraction module 706, which may be the same as or similar to extraction module 502, for example. Although illustrated as separate blocks, in some examples extraction module 706 may include machine learning model 702. Machine learning model 702 may receive training data from offline training module 704. For example, training data may include data from memory of a computing system that includes machine learning system 700 or from any combination of entities 502-518, illustrated in FIG. 5. Memory may store a history of requests and commitments received by and/or transmitted to the computing system or a particular user. Data from the memory or the entities may be used to train machine learning model 702. Subsequent to such training, machine learning model 702 may be employed by extraction module 706. Thus, for example, training using data from a history of requests and/or commitments for offline

training may act as initial conditions for the machine learning model. Other techniques for training, such as those involving featurization, described below, may be used.

[0072] FIG. 8 is a block diagram of a machine learning model 800, according to various examples. Machine learning model 800 may be the same as or similar to machine learning model 702 shown in FIG. 7. Machine learning model 800 includes any of a number of functional blocks, such as random forest block 802, support vector machine block 804, and graphical models block 806. Random forest block 802 may include an ensemble learning method for classification that operates by constructing decision trees at training time. Random forest block 802 may output the class that is the mode of the classes output by individual trees, for example. Random forest block 802 may function as a framework including several interchangeable parts that can be mixed and matched to create a large number of particular models. Constructing a machine learning model in such a framework involves determining directions of decisions used in each node, determining types of predictors to use in each leaf, determining splitting objectives to optimize in each node, determining methods for injecting randomness into the trees, and so on.

[0073] Support vector machine block 804 classifies data for machine learning model 800. Support vector machine block 804 may function as a supervised learning model with associated learning algorithms that analyze data and recognize patterns, used for classification and regression analysis. For example, given a set of training data, each marked as belonging to one of two categories, a support vector machine training algorithm builds a machine learning model that assigns new training data into one category or the other.

[0074] Graphical models block 806 functions as a probabilistic model for which a graph is a probabilistic graphical model that shows conditional dependence and independence among random variables. Probabilistic graphical models represent the joint probability distribution over a set of variables of interest. Probabilistic inference algorithms operate on these graphical models to perform inferences based on specific evidence. The inferences provide updates about probabilities of interest, such as the probability that a message or that a particular sentence contains a commitment or request. Learning procedures may construct such probabilistic models from data, with a process that discovers structure from a training set of unstructured information. Learning procedures may also construct such probabilistic models from explicit feedback from users (e.g., confirming whether extracted task information is correct or not). Applications of

graphical models, which may be used to infer task content from non-text content, may include information extraction, speech recognition, image recognition, computer vision, and decoding of low-density parity-check codes, just to name a few examples.

[0075] FIG. 9 is a block diagram illustrating example online and offline processes 900 involved in commitment and request extraction. Such processes may be performed by a processor (e.g., a processing unit) or a computing device, such as computing device 102 described above. "Offline" refers to a training phase in which a machine learning algorithm is trained using supervised/labeled training data (e.g., a set of emails with commitment and request sentences labeled). "Online" refers to an application of models that have been trained to extract commitments and requests from new (unseen) emails. A featurization process 902 and a model learning process 904 may be performed by the computing device offline or online. On the other hand, receiving a new message 906 and the process 908 of applying the model may occur online.

[0076] In some examples, any or all of featurization process 902, model learning process 904, and the process 908 of applying the model may be performed by an extraction module, such as extraction module 116 or 502. In other examples, featurization process 902 and/or model learning process 904 may be performed by a machine learning module (e.g., machine learning module 114, illustrated in FIG. 1), and the process 908 of applying the model may be performed by an extraction module.

[0077] In some examples, featurization process 902 may receive training data 910 and data 912 from various sources, such as any of entities 504-518, illustrated in FIG. 5. Featurization process 902 may generate feature sets of text fragments that are helpful for classification. Text fragments may comprise portions of content of one or more communications (e.g., generally a relatively large number of communications of training data 910). For example, text fragments may be words, terms, phrases, or combinations thereof. Model learning process 904 is a machine learning process that generates and iteratively improves a model used in process 908 for extracting task content, such as requests and commitments, from communications. For example, the model may be applied to a new message 906 (e.g., email, text, and so on). A computing device may perform model learning process 904 continuously, from time to time, or periodically, asynchronously from the process 908 of applying the model to new messages 906. Thus, for example, model learning process 904 may update or improve the model offline and independently from online process such as applying the model (or a current version of the model) to a message 906.

[0078] The process 908 of applying the model to new messages 906 may involve consideration of other information 914, which may be received from entities such as 504-518, described above. In some implementations, at least a portion of data 912 from other sources may be the same as other information 914. The process 908 of applying the model may result in extraction of task content included in new message 906. Such task content may include commitments and/or requests.

[0079] FIG. 10 is a flow diagram of an example task extraction process 1000 that may be performed by an extraction module or a processor (e.g., a processing unit). For example, process 1000 may be performed by computing device 102 (e.g., extraction module 116), illustrated in FIG. 1, or more specifically, in other examples, may be performed by extraction module 502, illustrated in FIG. 5.

[0080] At block 1002, the extraction module may analyze the content of an electronic communication to determine one or more meanings of the content. For example, such electronic communication may comprise emails, text messages, non-text content, social media posts, and so on. At block 1004, the extraction module may query content of one or more data sources that is related to the electronic communications. For example, one or more data sources may include any of entities 504-518 described in the example of FIG. 5. In another example, for the extraction module being extraction module 116, one or more data sources may include any portion of computer-readable media 108, described in the example of FIG. 1. The one or more data sources may be related to the electronic communications by subject, authors of the electronic communications, persons related to the authors, time, dates, history of events, and organizations, just to name a few examples.

[0081] At block 1006, the extraction module may automatically extract a request or commitment from the content. Such extraction may be based, at least in part, on (i) the one or more meanings of the content and (ii) the content of the one or more data sources.

[0082] In some implementations, the electronic communications comprise audio, an image, or video. A conversion module may be used to convert the audio, the image, or the video to corresponding text so as to generate content of the electronic communications. The content of the electronic communications may be provided to the extraction module.

[0083] In some implementations, an extraction module may perform process 1000 in real time.

[0084] The flow of operations illustrated in FIG. 10 is illustrated as a collection of blocks and/or arrows representing sequences of operations that can be implemented in hardware, software, firmware, or a combination thereof. The order in which the blocks are

described is not intended to be construed as a limitation, and any number of the described operations can be combined in any order to implement one or more methods, or alternate methods. Additionally, individual operations may be omitted from the flow of operations without departing from the spirit and scope of the subject matter described herein. In the context of software, the blocks represent computer-readable instructions that, when executed by one or more processors, configure the processor(s) to perform the recited operations. In the context of hardware, the blocks may represent one or more circuits (e.g., FPGAs, application specific integrated circuits – ASICs, etc.) configured to execute the recited operations.

[0085] Any routine descriptions, elements, or blocks in the flows of operations illustrated in FIG. 10 may represent modules, segments, or portions of code that include one or more executable instructions for implementing specific logical functions or elements in the routine.

EXAMPLE CLAUSES

[0086] A. A system comprising: a receiver port to receive content of an electronic communication; and an extraction module to: analyze the content to determine one or more meanings of the content of the electronic communication; query content of one or more data sources that is related to the electronic communication; and extract automatically a request or commitment from the content based, at least in part, on (i) the one or more meanings of the content and (ii) the content of the one or more data sources.

[0087] B. The system as paragraph A recites, wherein the content of the one or more data sources comprises personal data of one or more authors of the content of the electronic communication.

[0088] C. The system as paragraph A recites, wherein the electronic communication comprises audio, an image, or video, and further comprising: a conversion module to: convert the audio, the image, or the video to corresponding text to generate the content of the electronic communication; and provide the content of the electronic communication to the extraction module.

[0089] D. The system as paragraph A recites, wherein the extraction module is configured to analyze the content of the electronic communication by applying statistical models to the content of the electronic communication.

[0090] E. The system as paragraph A recites, wherein the extraction module is configured to augment the extracted request or commitment with identification of people and one or more locations associated with the extracted request or commitment.

[0091] F. The system as paragraph A recites, further comprising: a machine learning module configured to use the content of the electronic communication and/or the content of the one or more data sources as training data.

[0092] G. The system as paragraph A recites, wherein the extraction module is configured to (i) analyze the content of the electronic communication and (ii) automatically extract the request or commitment from the content of the electronic communication in real time.

[0093] H. A method comprising: receiving a message; applying language analysis to the message to automatically transform the message into machine language features; searching sources of data for information related to the message; receiving the information related to the message from the sources of data; and identifying automatically a request or commitment among the machine language features based, at least in part, on the received information.

[0094] I. The method as paragraph H recites, wherein the message comprises audio, an image, or a video, and wherein applying the language analysis to the message further comprises: determining text that corresponds to the audio, the image, or the video; and applying the language analysis to the text that corresponds to the audio, the image, or the video.

[0095] J. The method as paragraph H recites, wherein the sources of data related to the message comprise other messages.

[0096] K. The method as paragraph H recites, wherein the sources of data related to the message comprise one or more aspects of an author of the message.

[0097] L. The method as paragraph H recites, wherein receiving the message further comprises: sequentially receiving portions of the message during a time span; and during the time span, applying the language analysis to the received portions of the message.

[0098] M. The method as paragraph H recites, further comprising: flagging and/or annotating the message as containing the request or the commitment.

[0099] N. A computing device comprising: a transceiver port to receive and to transmit data; and a processor to: analyze an electronic message that is entered by a user via a user interface; search the data for content related to the electronic message; and extract, from the electronic message, text corresponding to a request or to a commitment based, at least in part, on the content related to the electronic message.

[00100] O. The computing device as paragraph N recites, wherein the processor is configured to: determine importance of the request or the commitment based, at least in part, on the content related to the electronic message.

[00101] P. The computing device as paragraph N recites, wherein the processor is configured to: apply the electronic message or the data as training data for a machine learning process.

[00102] Q. The computing device as paragraph P recites, wherein analyzing the electronic message is performed by the machine learning process.

[00103] R. The computing device as paragraph N recites, further comprising: an electronic display, and wherein the processor is further configured to generate an image to be displayed on the electronic display, wherein the image includes a prompt for the user to confirm whether the text corresponding to the request or to the commitment is accurate or true.

[00104] S. The computing device as paragraph N recites, wherein the processor is further configured to: analyze parameters of the electronic message, wherein the parameters include one or more of: number of recipients, length, date and time, and subject header of the individual electronic message.

[00105] T. The computing device as paragraph N recites, wherein the processor is further configured to: analyze information about the user while the user enters the electronic message.

[00106] Although the techniques have been described in language specific to structural features and/or methodological acts, it is to be understood that the appended claims are not necessarily limited to the features or acts described. Rather, the features and acts are described as example implementations of such techniques.

[00107] Unless otherwise noted, all of the methods and processes described above may be embodied in whole or in part by software code modules executed by one or more general purpose computers or processors. The code modules may be stored in any type of computer-readable storage medium or other computer storage device. Some or all of the methods may alternatively be implemented in whole or in part by specialized computer hardware, such as FPGAs, ASICs, etc.

[00108] Conditional language such as, among others, "can," "could," "might" or "may," unless specifically stated otherwise, are used to indicate that certain examples include, while other examples do not include, the noted features, elements and/or steps. Thus, unless otherwise stated, such conditional language is not intended to imply that features,

elements and/or steps are in any way required for one or more examples or that one or more examples necessarily include logic for deciding, with or without user input or prompting, whether these features, elements and/or steps are included or are to be performed in any particular example.

[00109] Conjunctive language such as the phrase "at least one of X, Y or Z," unless specifically stated otherwise, is to be understood to present that an item, term, etc. may be either X, or Y, or Z, or a combination thereof.

[00110] Many variations and modifications may be made to the above-described examples, the elements of which are to be understood as being among other acceptable examples. All such modifications and variations are intended to be included herein within the scope of this disclosure.

CLAIMS

1. A system comprising:

a receiver port to receive content of an electronic communication; and

an extraction module to:

analyze the content to determine one or more meanings of the content of the electronic communication;

query content of one or more data sources that is related to the electronic communication; and

extract automatically a request or commitment from the content based, at least in part, on (i) the one or more meanings of the content and (ii) the content of the one or more data sources.

2. The system of claim 1, wherein the content of the one or more data sources comprises personal data of one or more authors of the content of the electronic communication.

3. The system of claim 1, wherein the electronic communication comprises audio, an image, or video, and further comprising:

a conversion module to:

convert the audio, the image, or the video to corresponding text to generate the content of the electronic communication; and

provide the content of the electronic communication to the extraction module.

4. The system of claim 1, wherein the extraction module is configured to augment the extracted request or commitment with identification of people and one or more locations associated with the extracted request or commitment.

5. The system of claim 1, further comprising:

a machine learning module configured to use the content of the electronic communication and/or the content of the one or more data sources as training data.

6. A method comprising:

receiving a message;

applying language analysis to the message to automatically transform the message into machine language features;

searching sources of data for information related to the message;

receiving the information related to the message from the sources of data; and

identifying automatically a request or commitment among the machine language features based, at least in part, on the received information.

7. The method of claim 6, wherein the message comprises audio, an image, or a video, and wherein applying the language analysis to the message further comprises:

determining text that corresponds to the audio, the image, or the video; and

applying the language analysis to the text that corresponds to the audio, the image, or the video.

8. The method of claim 6, wherein receiving the message further comprises:

sequentially receiving portions of the message during a time span; and

during the time span, applying the language analysis to the received portions of the message.

9. The method of claim 6, further comprising:

flagging and/or annotating the message as containing the request or the commitment.

10. A computing device comprising:

a transceiver port to receive and to transmit data; and

a processor to:

analyze an electronic message that is entered by a user via a user interface;

search the data for content related to the electronic message; and

extract, from the electronic message, text corresponding to a request or to a commitment based, at least in part, on the content related to the electronic message.

11. The computing device of claim 10, wherein the processor is configured to:

determine importance of the request or the commitment based, at least in part, on the content related to the electronic message.

12. The computing device of claim 10, wherein the processor is configured to:

apply the electronic message or the data as training data for a machine learning process.

13. The computing device of claim 10, further comprising:

an electronic display, and wherein the processor is further configured to generate an image to be displayed on the electronic display, wherein the image includes a prompt for the user to confirm whether the text corresponding to the request or to the commitment is accurate or true.

14. The computing device of claim 10, wherein the processor is further configured to:

analyze parameters of the electronic message, wherein the parameters include one or more of: number of recipients, length, date and time, and subject header of the individual electronic message.

15. The computing device of claim 10, wherein the processor is further configured to:

analyze information about the user while the user enters the electronic message.

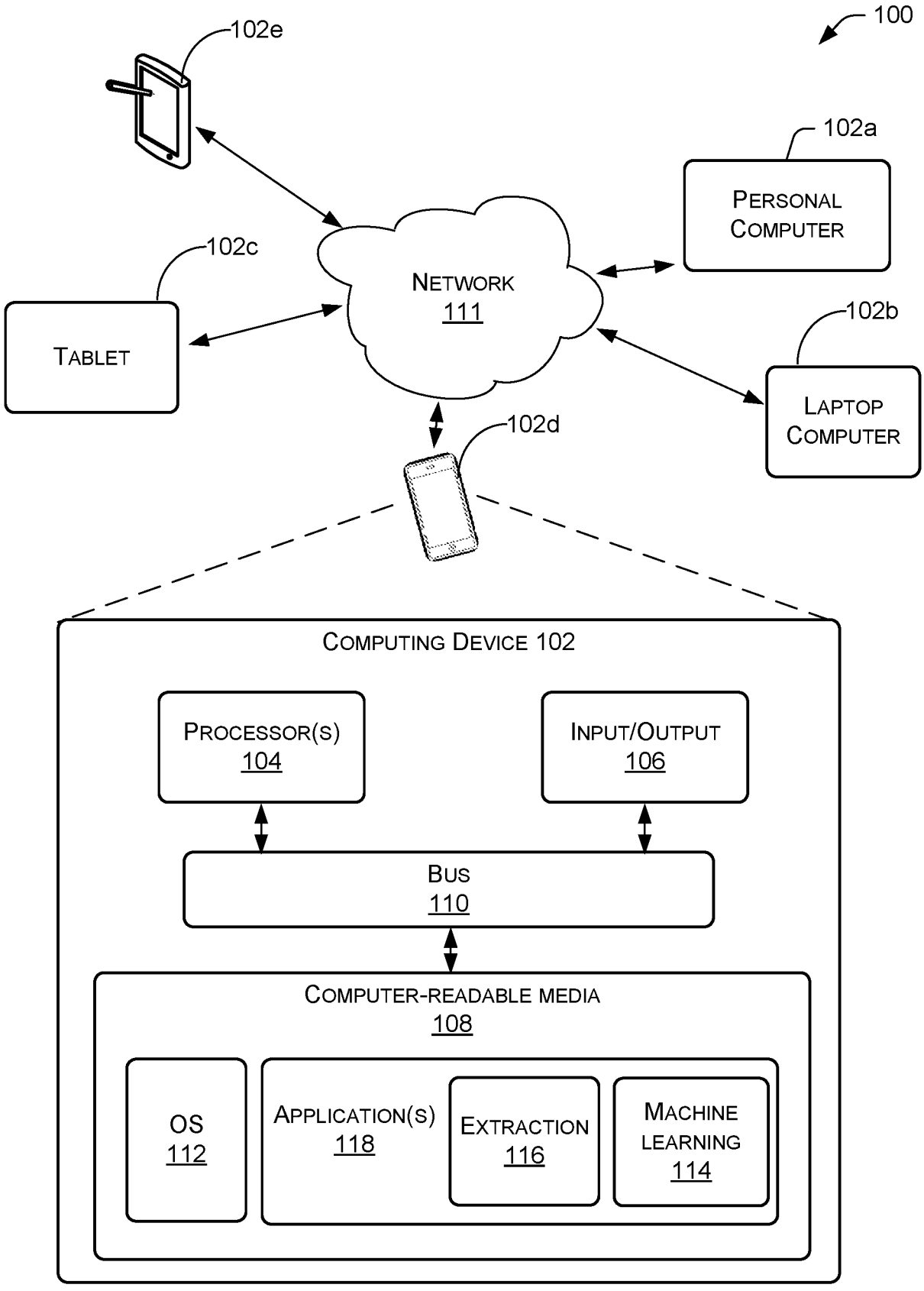
100
102e
102a
PERSONAL COMPUTER
NETWORK
111
102c
TABLET
102b
LAPTOP COMPUTER
102d
COMPUTING DEVICE 102
PROCESSOR(S)
104
INPUT/OUTPUT
106
BUS
110
COMPUTER-READABLE MEDIA
108
OS
112
APPLICATION(S)
118
EXTRACTION
116
MACHINE LEARNING
114

FIG. 1

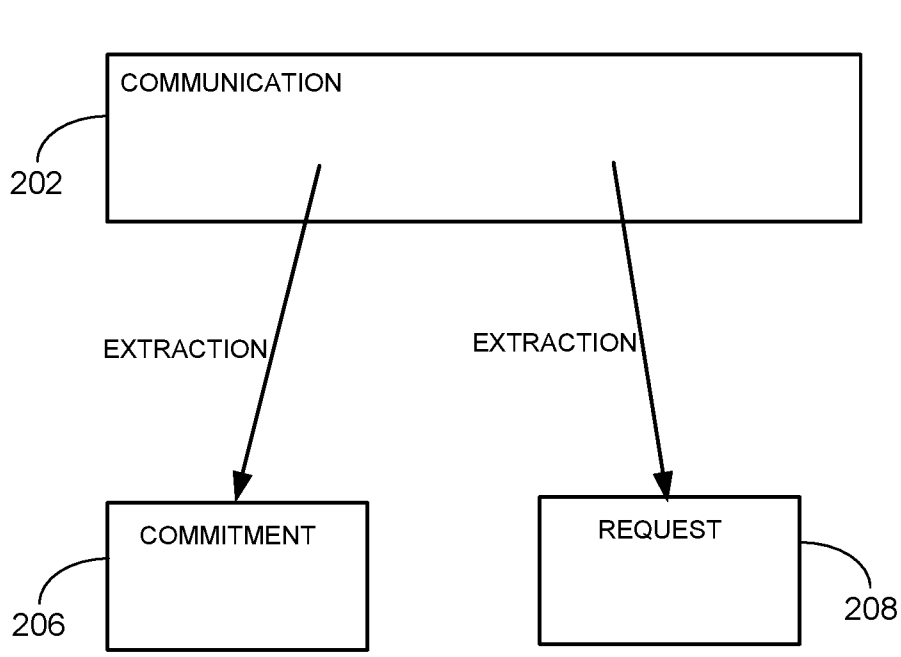
204
COMMUNICATION
202
EXTRACTION
EXTRACTION
COMMITMENT
206
REQUEST
208

FIG. 2

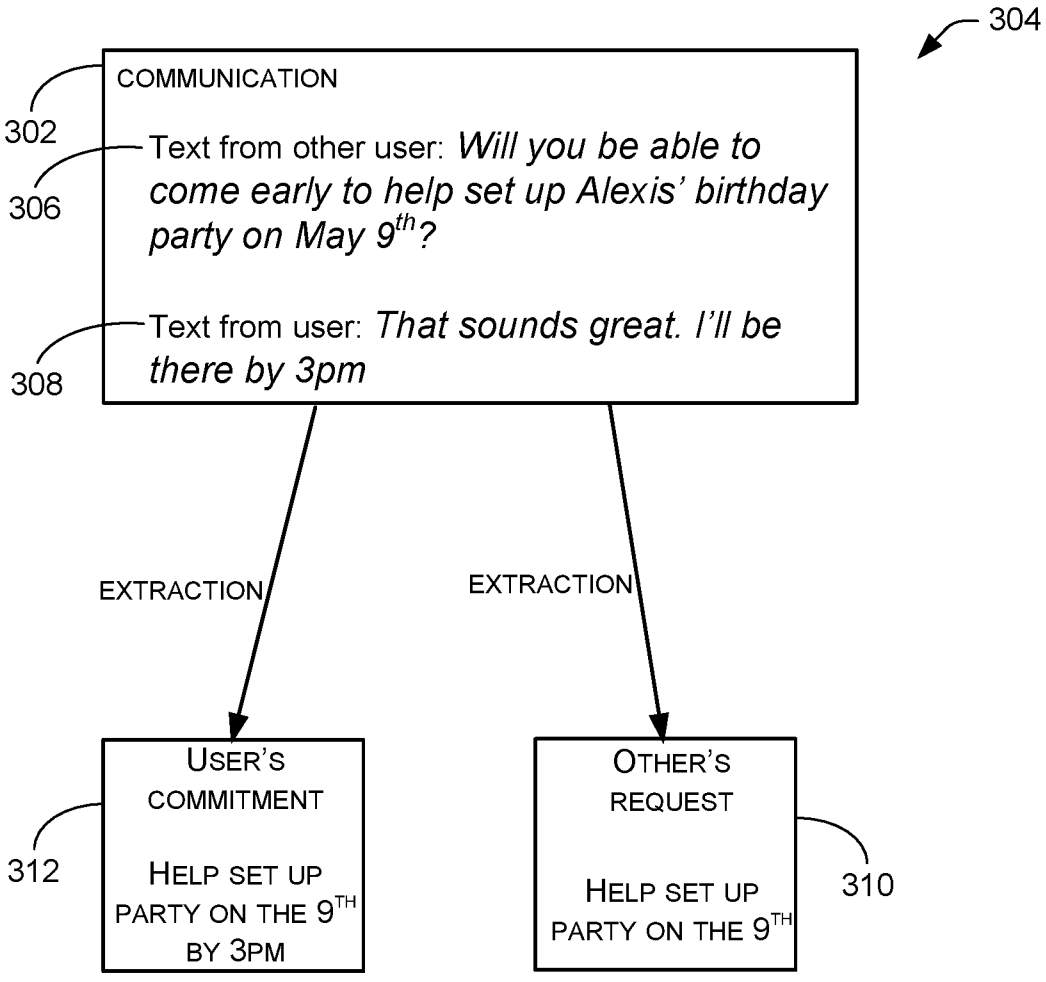
304
COMMUNICATION
302
Text from other user: Will you be able to come early to help set up Alexis' birthday party on May 9th?
306
Text from user: That sounds great. I'll be there by 3pm
308
EXTRACTION
EXTRACTION
USER'S COMMITMENT
HELP SET UP PARTY ON THE 9TH BY 3PM
312
OTHER'S REQUEST
HELP SET UP PARTY ON THE 9TH
310

FIG. 3

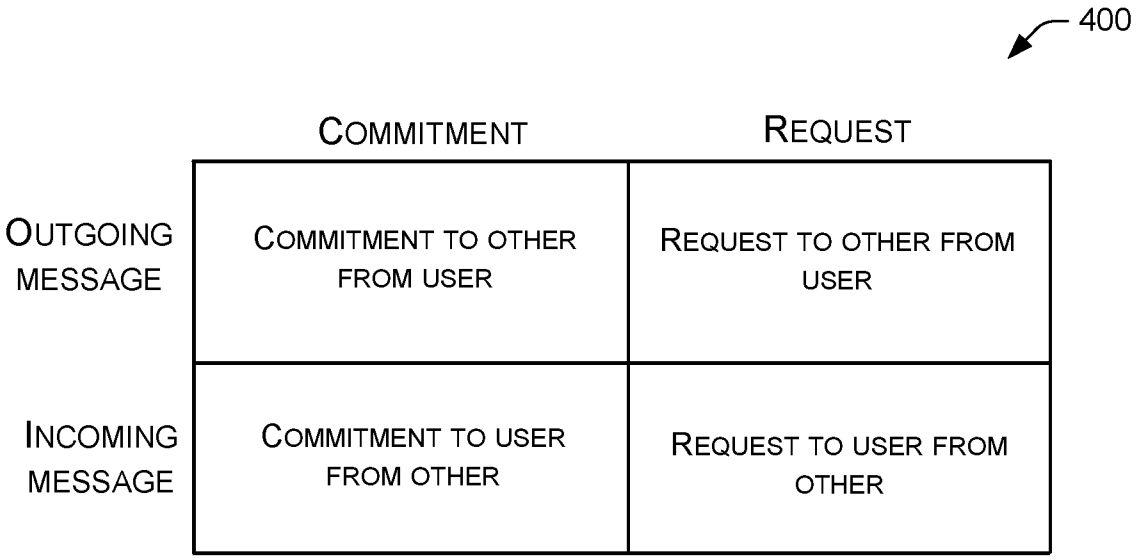
400
COMMITMENT
REQUEST
OUTGOING MESSAGE
INCOMING MESSAGE
COMMITMENT TO OTHER FROM USER
REQUEST TO OTHER FROM USER
COMMITMENT TO USER FROM OTHER
REQUEST TO USER FROM OTHER

FIG. 4

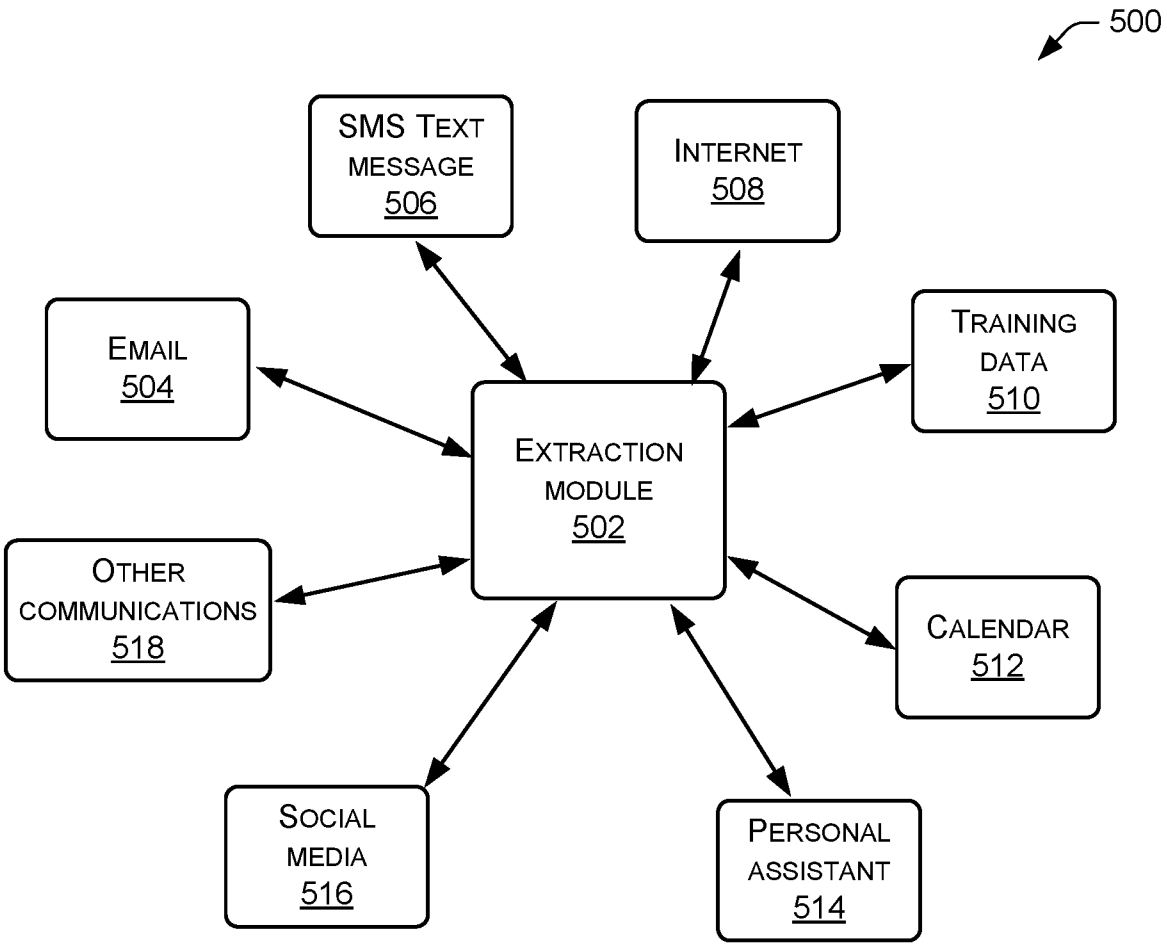
500
SMS TEXT MESSAGE 506
INTERNET 508
EMAIL 504
TRAINING DATA 510
EXTRACTION MODULE 502
OTHER COMMUNICATIONS 518
CALENDAR 512
SOCIAL MEDIA 516
PERSONAL ASSISTANT 514

FIG. 5

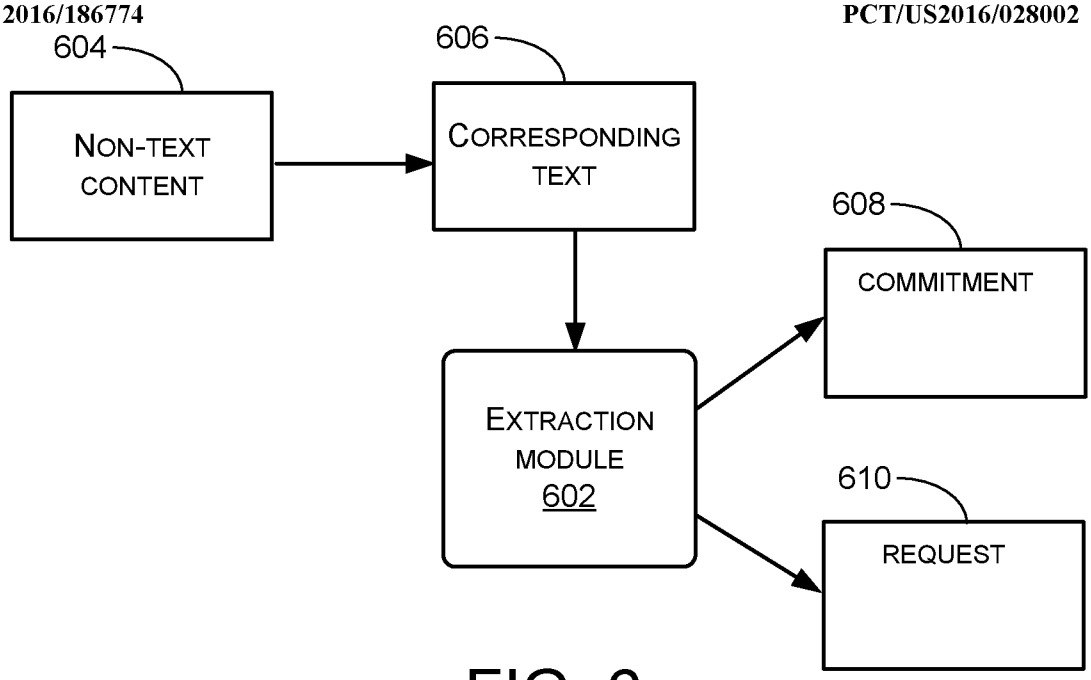

FIG. 6

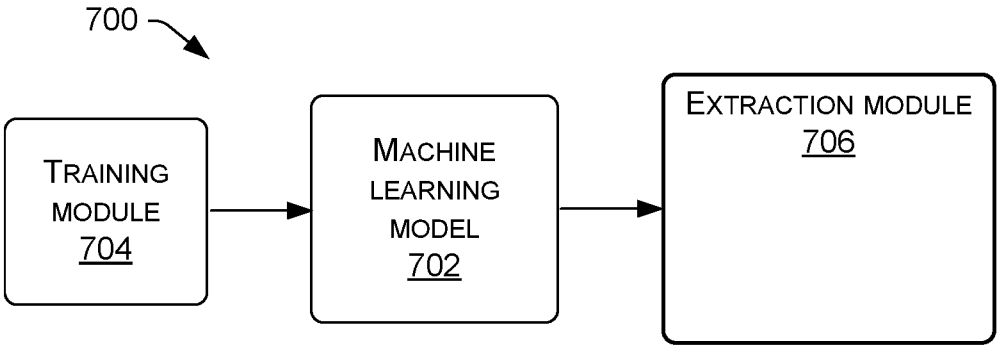

FIG. 7

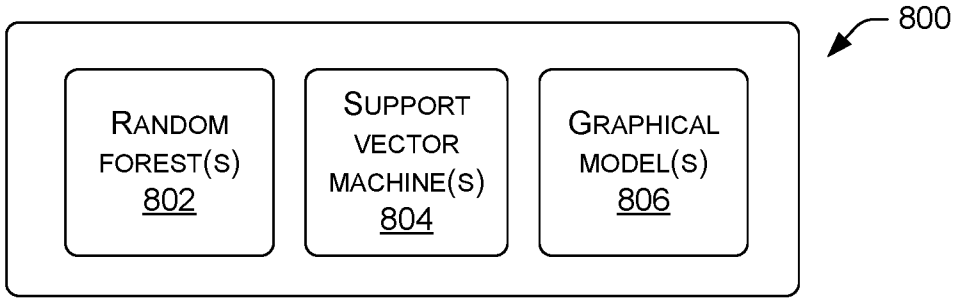

FIG. 8

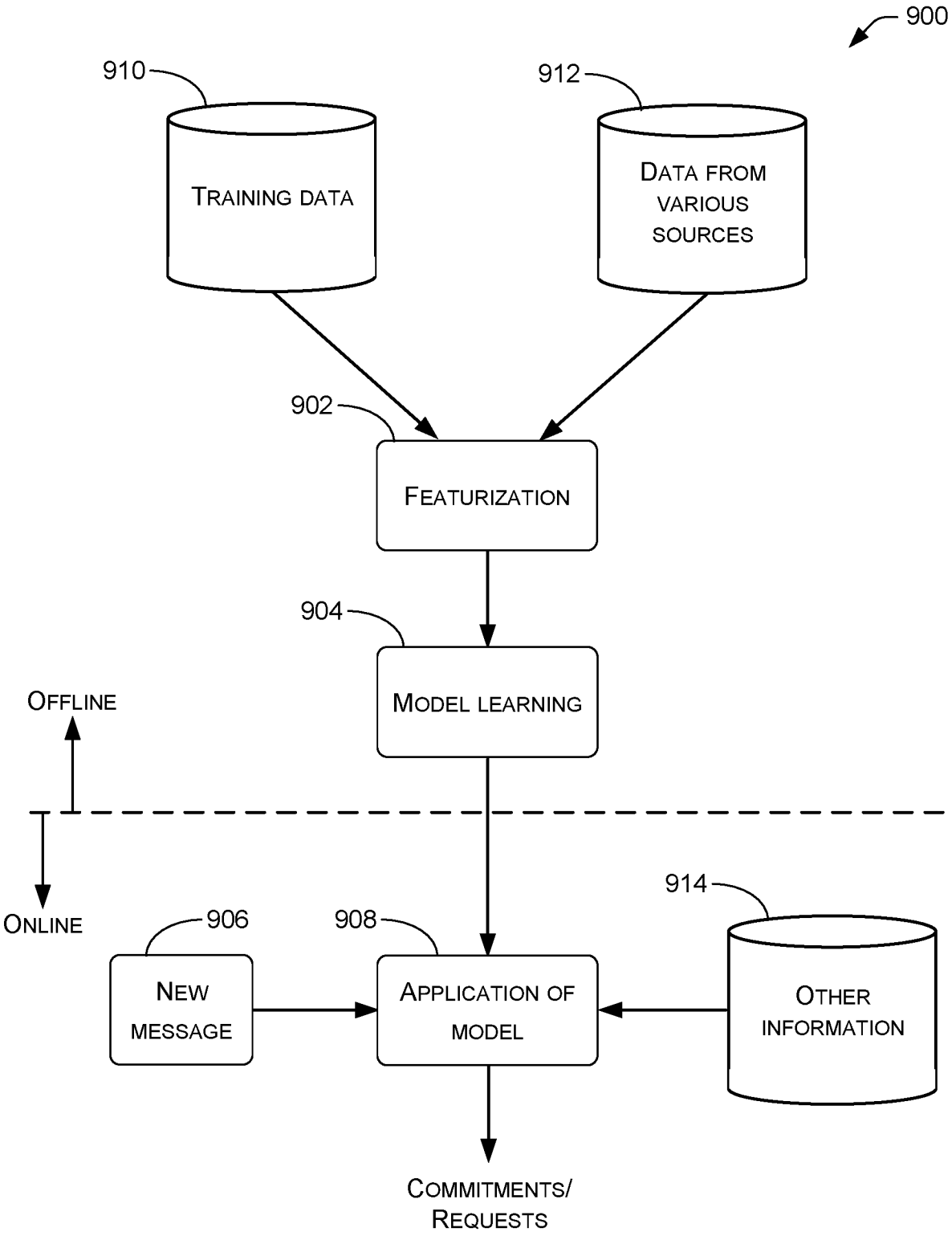
900
910
TRAINING DATA
912
DATA FROM VARIOUS SOURCES
902
FEATURIZATION
904
MODEL LEARNING
OFFLINE
ONLINE
906
NEW MESSAGE
908
APPLICATION OF MODEL
914
OTHER INFORMATION
COMMITMENTS/ REQUESTS

FIG. 9

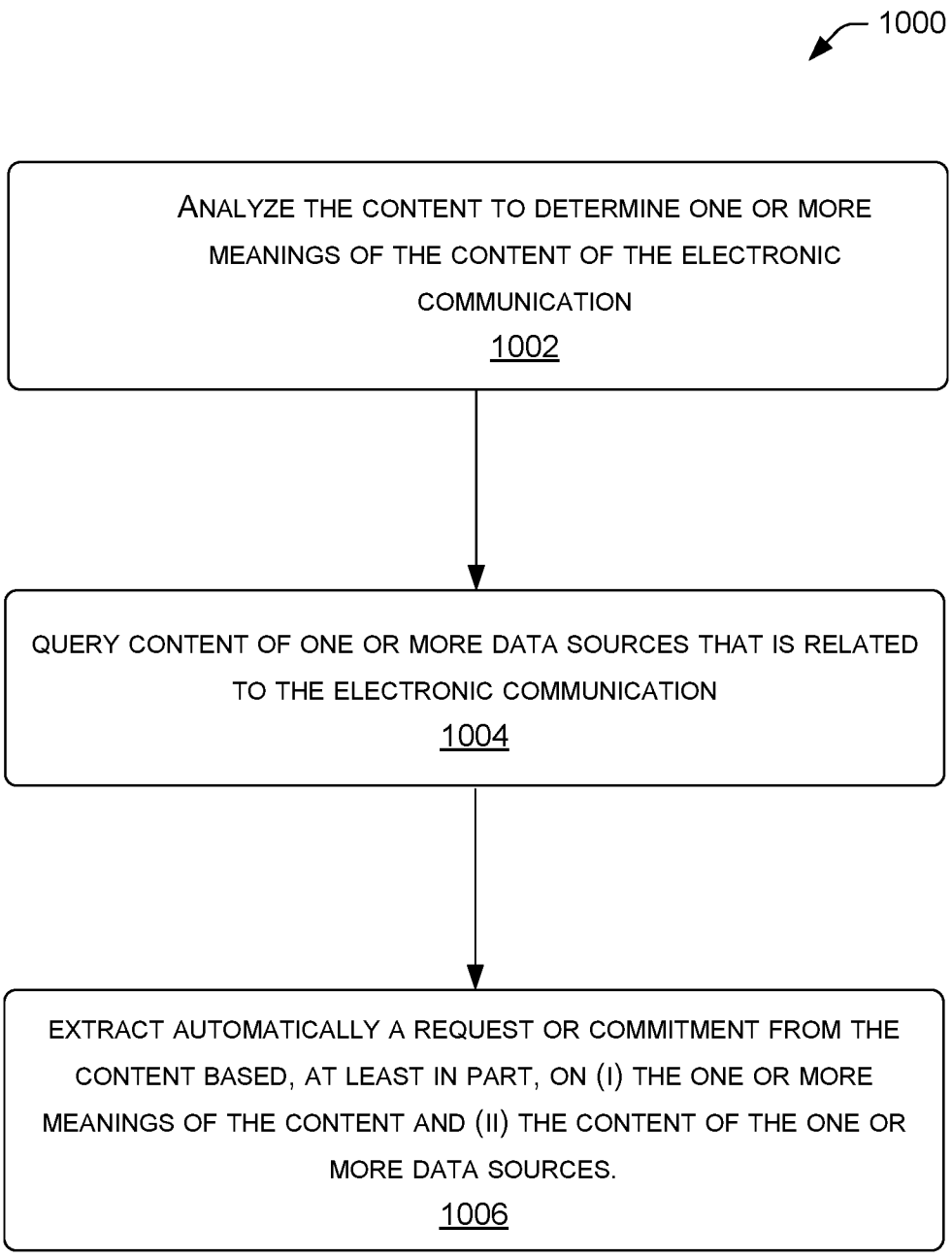
1000
ANALYZE THE CONTENT TO DETERMINE ONE OR MORE MEANINGS OF THE CONTENT OF THE ELECTRONIC COMMUNICATION
1002
QUERY CONTENT OF ONE OR MORE DATA SOURCES THAT IS RELATED TO THE ELECTRONIC COMMUNICATION
1004
EXTRACT AUTOMATICALLY A REQUEST OR COMMITMENT FROM THE CONTENT BASED, AT LEAST IN PART, ON (I) THE ONE OR MORE MEANINGS OF THE CONTENT AND (II) THE CONTENT OF THE ONE OR MORE DATA SOURCES.
1006

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/028002

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06Q10/06 G06Q10/10
ADD.

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)
G06Q

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/214404 A1 (KALIA ANUP KUMAR [US] ET AL) 31 July 2014 (2014-07-31) the whole document paragraph [0046] - paragraph [0050]; figure 4	1-15
X	US 2004/012638 A1 (DONNELLI RICHARD K [US] ET AL) 22 January 2004 (2004-01-22) the whole document	1-15
X	US 2013/179440 A1 (GORDON MERLYN [US]) 11 July 2013 (2013-07-11) paragraphs [0029], [0039], [0053]; figure 4 abstract; figures	1-15

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

"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	Date of mailing of the international search report
19 May 2016	30/05/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Blackley, William

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/028002

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/296832 A1 (BERINGER JOERG [US] ET AL) 22 November 2012 (2012-11-22) the whole document	1-15
X	US 2008/086300 A1 (ANISIMOVICH KONSTANTIN [RU] ET AL) 10 April 2008 (2008-04-10) abstract; figures paragraphs [0268], [0274]	1-15
X	US 2014/279622 A1 (LAMOUREUX MICHAEL G [CA] ET AL) 18 September 2014 (2014-09-18) paragraph [0106] - paragraph [0113]; figure 6 paragraph [0133] - paragraph [0148]; figures 9-11 paragraph [0160]	1-15
X	US 2008/147622 A1 (KOIKE ASAKO [JP]) 19 June 2008 (2008-06-19) paragraph [0010]; figures 1-3	1-15
A	MARCO PENNACCHIOTTI ET AL: "Automatically building training examples for entity extraction", COMPUTATIONAL NATURAL LANGUAGE LEARNING, ASSOCIATION FOR COMPUTATIONAL LINGUISTICS, N. EIGHT STREET, STROUDSBURG, PA, 18360 07960-1961 USA, 23 June 2011 (2011-06-23), pages 163-171, XP058006790, ISBN: 978-1-932432-92-3 the whole document	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2016/028002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014214404 A1	31-07-2014	NONE	
US 2004012638 A1	22-01-2004	NONE	
US 2013179440 A1	11-07-2013	NONE	
US 2012296832 A1	22-11-2012	NONE	
US 2008086300 A1	10-04-2008	US 2008086300 A1	10-04-2008
		US 2012232883 A1	13-09-2012
		US 2013191109 A1	25-07-2013
US 2014279622 A1	18-09-2014	NONE	
US 2008147622 A1	19-06-2008	JP 4865526 B2	01-02-2012
		JP 2008152522 A	03-07-2008
		US 2008147622 A1	19-06-2008

(19)中华人民共和国国家知识产权局

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G06F 17/30(2006.01)
G06F 17/27(2006.01)
H04L 12/58(2006.01)
G06N 3/08(2006.01)

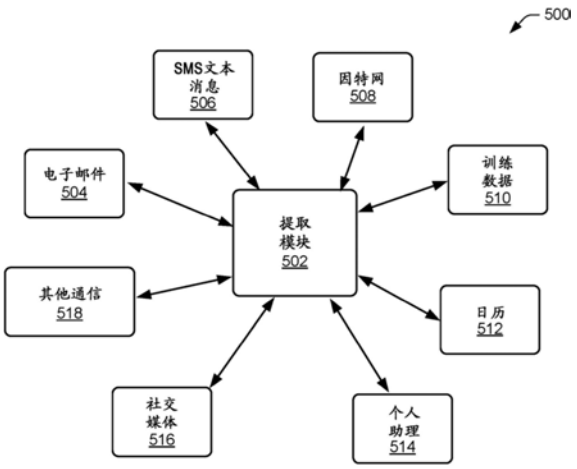
权利要求书2页 说明书15页 附图7页

(54)发明名称

自动提取通信和内容中的承诺和请求

(57)摘要

一种分析电子通信内容的系统，可以从电子通信中自动提取请求或承诺。在一个示例过程中，处理部件可以分析内容，以确定内容的一个或多个含义；查询与电子通信有关的一个或多个数据源的内容；并且至少部分地基于(i)内容的一个或多个含义以及(ii)一个或多个数据源的内容，从内容中自动标识和提取请求或承诺。初始识别和提取之后可以跟随多个动作，这些动作包括对请求或承诺的描述的确认和细化，以及协助跟踪和解决请求或承诺的发送者、接收者或其他人中的一个或多个的动作，这些动作包括创建附加消息、提醒、约定或待办事项列表。



CN 107636647 A

1.一种系统,包括:

接收端口,其用于接收电子通信的内容;以及

提取模块,其用于:

分析所述内容,以确定所述电子通信的所述内容的一个或多个含义;

查询与所述电子通信相关的一个或多个数据源的内容;以及

至少部分地基于(i)所述内容的所述一个或多个含义以及(ii)所述一个或多个数据源的所述内容,从所述内容中自动提取请求或承诺。

2.根据权利要求1所述的系统,其中所述一个或多个数据源的所述内容包括所述电子通信的所述内容的一个或多个作者的个人数据。

3.根据权利要求1所述的系统,其中所述电子通信包括音频、图像或视频,并且所述系统还包括:

转换模块,其用于:

将所述音频、所述图像或所述视频转换为对应的文本,以生成所述电子通信的所述内容;以及

向所述提取模块提供所述电子通信的所述内容。

4.根据权利要求1所述的系统,其中所述提取模块被配置成利用与提取的所述请求或承诺相关联的人员的标识和一个或多个位置,来扩充提取的所述请求或承诺。

5.根据权利要求1所述的系统,还包括:

机器学习模块,其被配置成使用所述电子通信的所述内容和/或所述一个或多个数据源的所述内容作为训练数据。

6.一种方法,包括:

接收消息;

将语言分析应用于所述消息,以将所述消息自动变换成机器语言特征;

针对与所述消息有关的信息,搜索数据源;

从所述数据源,接收与所述消息有关的所述信息;以及

至少部分地基于接收到的所述信息,自动标识所述机器语言特征中的请求或承诺。

7.根据权利要求6所述的方法,其中所述消息包括音频、图像或视频,并且其中将所述语言分析应用于所述消息还包括:

确定与所述音频、所述图像或所述视频相对应的文本;以及

将所述语言分析应用于与所述音频、所述图像或所述视频相对应的所述文本。

8.根据权利要求6所述的方法,其中接收所述消息还包括:

在一个时间间隔期间,顺序地接收所述消息的部分;以及

在所述时间间隔期间,将所述语言分析应用于所述消息的接收到的所述部分。

9.根据权利要求6所述的方法,还包括:

将所述消息标记和/或注释为包含所述请求或所述承诺。

10.一种计算设备,包括:

收发器端口,其用于接收和发送数据;以及

处理器,所述处理器用于:

分析由用户经由用户接口而输入的电子消息;

针对与所述电子消息有关的内容，搜索所述数据；以及

至少部分地基于与所述电子消息有关的所述内容，从所述电子消息中提取与请求或承诺相对应的文本。

11.根据权利要求10所述的计算设备，其中所述处理器被配置成：

至少部分地基于与所述电子消息有关的所述内容，确定所述请求或者所述承诺的重要性。

12.根据权利要求10所述的计算设备，其中所述处理器被配置成：

将所述电子消息或所述数据作为训练数据而应用于机器学习过程。

13.根据权利要求10所述的计算设备，还包括：

电子显示器，并且其中所述处理器还被配置成生成在所述电子显示器上待显示的图像，其中所述图像包括一个提示，所述提示用于所述用户确认与所述请求或所述承诺相对应的所述文本是否准确或者正确。

14.根据权利要求10所述的计算设备，其中所述处理器还被配置成：

分析所述电子消息的参数，其中所述参数包括以下各项中的一项或多项：个别电子消息的接收者数目、长度、日期与时间以及主题报头。

15.根据权利要求10所述的计算设备，其中所述处理器还被配置成：

在所述用户输入所述电子消息的同时，分析关于所述用户的信息。

自动提取通信和内容中的承诺和请求

背景技术

[0001] 电子通信已经成为社交和商业交互的重要形式。仅作为几个示例，这样的电子通信包括电子邮件、日历、SMS文本消息、语音邮件、图像、视频以及其他数字通信和内容。电子通信可以由用户在若干个计算设备中的任一计算设备上自动或手动地生成。

发明内容

[0002] 本公开描述了用于标识电子通信(诸如用户之间或用户之中的消息)中的请求和承诺的技术和体系架构。例如，两个人之间的电子邮件交换可以包括向第二人发送请求以执行任务的第一人的文本，并且可以包括利用指示执行任务的承诺的消息来做出响应的第二人的文本。电子邮件交换可以传递足够的信息，以便系统自动确定执行任务的请求和/或接收者执行任务的承诺的存在，以及确定发起请求的人的标识和利用执行任务或有助于完成任务的承诺而做出响应的人的标识。如果电子邮件交换未传达足够的信息，以便确定请求和/或承诺的存在，则系统可以查询可能与电子邮件交换的一个或多个部分有关的其他信息源。例如，系统可以检查诸如包含在所维护的电子邮件的“线程”中的消息之类的更长历史的消息，或者可以查询电子邮件交换的作者中的一个或两个的日历或数据库，以获取附加信息。该系统还可以从通信中涉及的用户中的一个或多个，来寻求确认关于潜在请求的存在或在给定关于请求或者承诺的不确定性水平的情况下而执行任务的承诺的存在。

[0003] 提供本发明内容是为了以简化形式介绍下文将在具体实施方式中进一步描述的概念的选择。本发明内容并非旨在标识所要求保护的主题的关键特征或必要特征，也不是旨在用作确定所要求保护的主题的范围的辅助手段。例如，术语“技术”可以指一个或多个系统、一个或多个方法、计算机可读指令、一个或多个模块、算法、硬件逻辑(例如，现场可编程门阵列(FPGA)、专用集成电路(ASIC)、专用标准产品(ASSP)、片上系统(SOC)、复杂可编程逻辑器件(CPLD))和/或上述上下文和整个文件所准许的其他一个或多个技术。

附图说明

[0004] 参照附图对具体实施方式进行描述。在这些附图中，附图标记的最左边的一个或多个数字标识附图标记首次出现在其中的附图。不同附图中的相同附图标记指示相似或相同的项目。

[0005] 图1是描绘其中可以实现本文中所描述的技术的示例环境的框图。

[0006] 图2是图示了进行示例任务提取过程的电子通信的框图。

[0007] 图3是图示了包括示例文本线程以及请求和承诺的任务提取过程的电子通信的框图。

[0008] 图4是消息、承诺和请求中的示例关系表。

[0009] 图5是可以与示例提取模块通信的多个信息源的框图。

[0010] 图6是作用于非文本通信的示例提取模块的框图。

[0011] 图7是示例机器学习系统的框图。

[0012] 图8是示例机器学习模型的框图。

[0013] 图9是图示了用于承诺和请求提取的示例在线和离线过程的框图。

[0014] 图10是示例任务提取过程的流程图。

具体实施方式

[0015] 各种示例描述了用于系统的技术和体系架构，除了其他之外，该系统执行从电子通信中提取任务，该电子通信诸如是一个或多个用户之间或一个或多个用户之中的消息(例如，单个用户可以向自己或一个或多个其他用户来发送消息)。例如，两个人之间的电子邮件交换可以包括来自向第二人发送请求以执行任务的第一人的文本，并且可以包括做出执行任务的承诺(例如，同意)第二人的文本。电子邮件交换可以传递足够的信息，以供系统自动确定执行任务的请求和/或执行任务的承诺的存在。在一些实现方式中，电子邮件交换未传递足够的信息，以供确定请求和/或承诺的存在。不管否是这种情况，系统都可以查询可能与电子邮件交换的一个或多个部分有关的其他信息源。例如，系统可以检查由电子邮件交换的作者中的一个或两个或由其他人所交换的其他消息。该系统还可以检查更大的电子邮件和其他消息的语料库。除了其他消息之外，系统还可以查询电子邮件交换的作者中的一个或两个的日历或数据库，以获取更多信息。在一些实现方式中，系统可以查询作者中的一个或两个的相应位置处交通或天气状况。

[0016] 在本文中，“提取”用于描述确定通信中的请求或者承诺。例如，系统可以从一系列文本消息中提取请求或承诺。在本文中，系统正在确定或标识来自一系列文本消息的请求或承诺，但不一定是从该系列文本消息中移除请求或承诺。换言之，除非特别举例说明，否则本文中所使用的上下文中的“提取”并不意指“移除”。

[0017] 本文中，从通信中提取请求和/或承诺的过程，可以被描述为提取“任务内容”的过程。换言之，如本文中所描述的“任务内容”是指一个或多个请求、一个或多个承诺和/或包括在通信意义上所传递的请求和承诺的组合的项目。在各种实现方式中，可以标识以及提取承诺和请求之间的相互作用(interplay)。例如，这样的相互作用可以是对请求者的承诺生成针对请求者和/或第三方(例如，个人、群组、处理部件等)的一个或多个请求的地方。例如，工程经理对请求的完成产量分析的承诺可能生成针对生产数据的制造团队的二级请求。

[0018] 在各种实现方式中，过程可以提取包含承诺或请求的文本的片段。例如，段落可以包括该段落的第二句中的承诺或请求。附加地，该过程可以提取包含承诺或请求的文本片段、句子或段落，诸如段落中的第三句或各种单词短语。

[0019] 在各种实现方式中，过程可以利用与所提取的任务内容相关联的人员的标识和一个或多个位置，来扩充所提取的任务内容(例如，请求或承诺)。例如，所提取的请求可以被存储或被利用附加信息(诸如，一个或多个请求者和/或一个或多个被请求者的标识、相关位置、时间/日期等)而处理。

[0020] 一旦由计算系统标识并且提取，通信的任务内容(例如，承诺或请求提议或确认)可以被进一步处理或分析，以标识或推断承诺或请求的语义，包括：标识请求或承诺的主要所有者(例如，如果不是通信中的各方)、任务内容及其特性的性质(例如，其描述或概括)、所指定或推断的相关日期(例如，完成承诺或请求的最后期限)、相关响应，诸如初始回复或

后续消息以及他们的预期时间(例如,每个礼节预期或围绕人员之中的任务完成的有效通信或每个组织)、以及要用于满足请求的信息资源。例如,这样的信息资源可以提供关于时间、人员、地点等的信息。所标识的任务内容和关于任务内容的推论可以用于驱动自动(例如,由计算机生成的)服务,该服务诸如是提醒、待办事项清单的修订(例如,和显示)、约定、会议请求和其他时间管理活动。在一些示例中,这样的自动服务可以在消息的构成(例如,输入电子邮件或文本)期间、读取消息期间或者在其他时间(诸如,在服务器或客户端设备上离线处理电子邮件期间)而被应用。关于请求或承诺的初始提取和推断还可以调用与一个或多个参与者一起工作的自动化服务,以至少部分地基于标识遗漏信息或关于从通信中检测或推断的一个或多个特性的不确定性,来确认或细化当前对请求或承诺以及请求或承诺的状态的理解或推断。

[0021] 在一些示例中,可以从多种形式的通信中提取任务内容,包括捕获人际交流的数字内容(例如,电子邮件、SMS文本、即时消息发送、电话呼叫、社交媒体中的发布等)以及所构成的内容(例如,电子邮件、便签制作和组织工具,诸如华盛顿州雷蒙德市的微软公司的OneNote®,文字处理文档等)。

[0022] 如下文所描述的,用于从各种形式的电子通信中,标识和提取任务内容的一些示例技术可以涉及电子通信的内容的语言分析,人类注释者可以将该电子通信的内容注释为包含承诺或请求。人类注释可以用于生成训练数据语料库的过程,该语料库用于构建和测试承诺或请求以及关于承诺或请求的各种特性的自动提取。这些技术还可以涉及人类生成的标签的代理(例如,基于电子邮件接合数据或相对复杂的提取方法)。为了开发在提取系统中使用的方法或者用于实时使用用于标识和/或推断任务或承诺及其特性的方法,分析可以包括沿着复杂性图谱不同点处的自然语言处理(NLP)分析。例如,具有相对较低水平的复杂性的分析,可能涉及基于简单的单词断开和提取来标识关键词。具有相对中级水平的复杂性的分析,可能涉及考虑更大量的单词集合(“单词袋”)分析。具有相对较高水平的复杂性的分析,可能涉及将通信中的句子复杂地解析为解析树和逻辑形式。用于标识和提取任务内容的技术可以涉及标识消息部件和消息句子的属性或“特征”。这样的技术可以在训练和测试范例中,采用这些特征来构件统计模型,以对消息的部件进行分类。例如,这样的部件可以包括句子或整个消息作为包含请求和/或承诺,并且还标识和/或概括最佳描述请求和/或承诺的文本。

[0023] 在一些示例中,用于提取的技术可以涉及分析层次,这包括使用以句子为中心的方法,考虑消息中的多个句子以及相对长的通信线程的全局分析。在一些实现方式中,这样相对长的通信线程可以包括一段时间内消息集合、以及线程和更长期通信(例如,跨越几天、几周、几月或几年)的集合。可以考虑与特定通信相关联的多个内容源。这些源可以包括与特定通信相关联的人员、一段时间内人员的位置、人员的日历信息、组织的多个方面以及与人员相关联的组织结构的细节之间的历史和/或关系。

[0024] 在一些示例中,技术可以直接考虑从内容部件所标识的请求或者承诺,以作为请求或者承诺的代表,或者可以进一步被概括。技术可以从句子或更大的消息中,提取其他信息,包括相关日期(例如,请求或承诺到期的期限)、位置、紧急性、时间要求、任务主题(例如,项目)和人员。在一些实现方式中,通过将承诺和/或请求归于消息的特定作者,确定所提取的任务内容的特性。例如,在具有多个收件人的多方电子邮件的情况下,这可能特别有

用。

[0025] 除了消息的文本之外，技术可以考虑用于提取和概括的其他信息，仅作为几个示例，这些其他信息诸如是图像和其他图形内容、消息的结构、主题报头、消息长度、句子或短语在消息中的位置、消息的发送日期/时间以及关于消息的发送者和接收者的信息。技术还可以考虑消息本身的特征(例如，接收者数目、回复数目、总长度等)以及上下文(例如，星期几)。在一些实现方式中，技术可以至少部分地基于通信的发送者或一个或多个接收者以及组织的结构和/或通信的历史，来进一步细化或优先化候选消息/内容或所得提取的初始分析。

[0026] 在一些示例中，技术可以包括分析当前通信之外的各种通信(例如电子邮件、文本等)的特征。例如，技术可以考虑承诺和请求之间或在其之中的交互，诸如通信线程的早期部分是否包含承诺或请求、先前在通信线程等的两个(或者，更多个)用户之间做所出的承诺和/或请求的数目等。

[0027] 在一些示例中，技术可以包括分析包括条件任务内容承诺或请求的各种通信的特征。例如，条件承诺可能是“如果我看到他，我会让他知道”。条件要求可能是“如果明天天气晴朗，请给房子刷油漆”。

[0028] 在一些示例中，技术可以包括利用与任务内容相关联的人员以及在任务内容中所提及的地点的附加信息(诸如最终期限、标识(例如，姓名、ID号等))，来扩充所提取的任务内容(例如，承诺和/或请求)。

[0029] 在一些示例中，一种计算系统可以使用机器学习程序，构造用于标识和提取请求和承诺以及相关信息的预测模型，该机器学习过程对句子或消息(例如，机器学习特征)的注释语料库的训练集合进行操作。在其他示例中，计算系统可以使用相对简单的基于规则的方法，来执行提取和概括。

[0030] 在一些示例中，一种计算系统可以显式标注从消息本身中的消息中所提取的任务内容。在各种实现方式中，计算系统可以标记包含在多个电子服务和体验中的请求和承诺的消息，该消息可以包括产品或服务，诸如经由Windows®、Cortana®、Outlook®、Outlook WebApp®(OWA)、Xbox®、Skype®、Lync®和Band®所提供的产品和服务所显现的产品或服务，以及来自其他人的其他此类服务和经验。在各种实现方式中，计算系统可以从音频馈送提取请求和承诺，仅作为几个示例，该音频馈送诸如是从电话呼叫或语音邮件消息、SMS图像、即时消息发送流以及口头请求到数字私人助理的音频馈送。

[0031] 在一些示例中，计算系统可以学习改善用于通过用户的隐式反馈和显式反馈，提取任务内容的预测模型和概括。例如，这样的反馈可以包括关于所提取的内容是正确还是不正确的用户输入(例如，响应于所显示的提取的任务内容)。例如，这样的反馈可以由计算机系统量化和/或存储，并且随后应用于预测模型。

[0032] 参考图1至图10进一步对各种示例进行描述。

[0033] 下文所描述的环境仅构成一个示例，其并不旨在将权利要求限制于任一特定操作环境。在不背离所要求保护的主题的精神和范围的情况下，也可以使用其他环境。

[0034] 图1图示了其中可以操作如本文中所描述的涉及任务提取的示例过程的示例环境100。在一些示例中，环境100的各种设备和/或部件包括多种计算设备102。作为示例而非限制，计算设备102可以包括设备102a至102e。尽管被图示为多种多样的设备类型，但是计算

设备102也可以是其他设备类型，而不限于所示出的设备类型。计算设备102可以包括具有例如经由总线110可操作地连接到输入/输出接口106和计算机可读介质108的一个或多个处理器104的任何类型的设备。计算设备102可以包括个人计算机，诸如例如台式计算机102a、膝上型计算机102b、平板电脑102c、电信设备102d、个人数字助理(PDA)102e、电子书阅读器、可穿戴式计算机(例如，智能手表、个人健康追踪配件等)、汽车计算机、游戏设备等。计算设备102还可以包括例如服务器计算机、瘦客户端、终端和/或工作站。在一些示例中，计算设备102可以包括用于集成在计算设备、器械或其他种类的设备中的部件。

[0035] 在一些示例中，被描述为由计算设备102执行的功能中的一些或全部功能可以由一个或多个远程对等计算设备、远程服务器或多个服务器或分布式计算资源(例如，经由云计算)来实现。在一些示例中，计算设备102可以包括用于接收电子通信的输入端口。计算设备102可以进一步包括一个或多个处理器104，以访问与特定电子通信有关或相关联的各种信息源。仅作为几个示例，这样的信息源可以包括电子日历和关于电子通信中包括的消息的作者的历史或个人信息的数据库。在一些实现方式中，在多个处理器104中的任一处理器可以访问作者的个人信息之前，作者必须“选中”或采取其他肯定动作。在一些示例中，一个或多个处理器104可以被配置成从电子通信提取任务内容。一个或多个处理器104可以是硬件处理器或软件处理器。如本文中所使用的，处理单元指定硬件处理器。

[0036] 在一些示例中，如关于设备102d所示，计算机可读介质108可以存储可由一个或多个处理器104执行的指令，其包括操作系统(OS)112、机器学习模块114、提取模块116以及可由一个或多个处理器104加载和执行的程序或应用118。一个或多个处理器104可以包括一个或多个中央处理单元(CPU)、图形处理单元(GPU)、视频缓冲处理器等。在一些实现方式中，机器学习模块114包括存储在计算机可读介质108中的可执行代码，并且可由一个或多个处理器104执行，以经由输入/输出106由计算设备102在本地或远程收集信息。该信息可以与应用118中的一个或多个应用相关联。机器学习模块114可以选择性地应用存储在计算机可读介质108(或者更特定地，存储在机器学习114中)的若干个机器学习决策模型中的任何一个，以应用于输入数据。

[0037] 在一些实现方式中，提取模块116包括存储在计算机可读介质108中的可执行代码，并且提取模块可由一个或多个处理器104执行以经由输入/输出106由计算设备102在本地或远程收集信息。该信息与应用118中的一个或多个应用相关联。提取模块116可以选择性地应用存储在计算机可读介质108中的若干个统计模型或预测模型中的任一(例如，经由机器学习模块114)，以应用于输入数据。

[0038] 尽管某些模块已被描述为执行各种操作，但这些模块仅仅是示例性的，并且可以通过更多或更少数目个模块来执行相同或相似的功能。而且，由所描绘模块执行的功能不一定由单个设备在本地执行。相反，一些操作可以由远程设备(例如，对等、服务器、云等)执行。

[0039] 可替换地或附加地，本文中所描述的功能中的一些或全部可以至少部分地由一个或多个硬件逻辑部件来执行。作为示例但不受限地，可使用的说明性类型的硬件逻辑部件包括现场可编程门阵列(FPGA)、程序专用集成电路(ASIC)、程序专用标准产品(ASSP)、片上系统(SOC)、复杂可编程逻辑器件(CPLD)等。

[0040] 在一些示例中，计算设备102可以与能够捕获图像和/或视频的相机和/或能够捕

获音频的麦克风相关联。例如，输入/输出模块106可以被并入到这样的相机和/或麦克风。例如，对象或文本的图像可以被转换为与图像的内容和/或含义相对应并且针对任务内容进行分析的文本。语音的音频可以被转换成文本并且针对任务内容进行分析。

[0041] 计算机可读介质包括计算机存储介质和/或通信介质。计算机存储介质包括以用于存储诸如计算机可读指令、数据结构、程序模块或其他数据之类信息的任何方法或技术而实现的易失性和非易失性、可移除和不可移除介质。计算机存储介质包括但不限于相变存储器(PRAM)、静态随机存取存储器(SRAM)、动态随机存取存储器(DRAM)、其他类型的随机存取存储器(RAM)、只读存储器(ROM)、电可擦除可编程只读存储器(EEPROM)、闪存或其他存储器技术、光盘只读存储器(CD-ROM)、数字多功能盘(DVD)或其他光学存储装置、磁带盒、磁带、磁盘存储装置或其他磁存储设备或者可以用于存储以供计算设备访问的信息的任何其他非传输介质。

[0042] 相比之下，通信介质包含计算机可读指令、数据结构、程序模块或调制数据信号(诸如载波或其他发送机制)中的其他数据。如本文中所定义的，计算机存储介质不包括通信介质。在各种示例中，存储器108是存储计算机可执行指令的计算机存储介质的示例。当由处理器104执行时，计算机可执行指令配置一个或多个处理器，除了其他之外，分析个别电子消息的内容，以及至少部分地基于分析内容，从电子消息中提取与请求或承诺相对应的文本，其中该电子消息是(i)在电子通信之中被接收到，(ii)由用户经由用户接口而被输入，或(iii)从存储器中而被检索

[0043] 在各种示例中，输入/输出(I/O)接口106的输入设备或与其连接的输入设备，可以是直接触摸输入设备(例如触摸屏)、间接触摸设备(例如触摸垫)、间接输入设备(例如鼠标、键盘、相机或相机阵列等)或其他类型的非触觉设备(例如音频输入设备)。

[0044] 一个或多个计算设备102还可以包括一个或多个输入/输出(I/O)接口106，其可以包括一个或多个通信接口，以使得能够通过网络111实现计算设备102和在提取任务内容时涉及的其他联网计算设备或其他计算设备之间的有线或无线通信。这样的通信接口可以包括一个或多个收发器设备，例如诸如以太网网络接口控制器NIC或其他类型的收发器设备之类的网络接口控制器(NIC)，以通过网络111发送和接收通信。处理器104(例如处理单元)可以通过相应的通信接口交换数据。在一些示例中，通信接口可以是PCIe收发器，并且网络111可以是PCIe总线。在一些示例中，通信接口可以包括但不限于，用于蜂窝(3G、4G或其他)、WI-FI、超宽带(UWB)、蓝牙或卫星传输的收发器。通信接口可以包括有线I/O接口，诸如以太网接口、串行接口、通用串行总线(USB)接口、INFINIBAND接口或其他有线接口。为了简单起见，在图示的计算设备102中省略了这些和其他部件。输入/输出(I/O)接口106可以允许设备102与其他设备通信，该其他设备诸如用户输入外围设备(例如键盘、鼠标、笔、游戏控制器、话音输入设备、触摸输入设备、手势输入设备等)和/或输出外围设备(例如显示器、打印机、音频扬声器、触觉输出等)。

[0045] 图2是图示了进行示例任务提取过程204的电子通信202的框图。例如，过程204可以涉及用于检测在输入或输出通信中是否已经做出承诺206或请求208的若干种技术中的任一技术。过程204还可以涉及用于自动标记、注释或以其他方式将消息标识为包含承诺或请求的技术。在一些示例中，过程204可以包括提取用于呈现和随动跟踪和分析的承诺或请求的概括(未图示)的技术。可以从多种形式的电子通信202的内容中，提取承诺206或请求

208。这样的内容可以包括人际交流，诸如电子邮件、SMS文本或图像、即时消息发送、社交媒体中的发布、会议便签等。这样的内容还可以包括使用电子邮件应用或文字处理应用而组成的内容等。

[0046] 在一些示例中，任务提取过程204可以提取关于第三方的任务内容。例如，诸如电子邮件之类的电子通信202可以包括回复电子邮件的第一人的承诺。这个承诺可能是第一人承诺。然而，这种承诺可能是第三人承诺，其是第一人(回复电子邮件)代表另一人的承诺。例如，第一人可能是主管，该主管对执行任务的下属的副总来建立承诺。对于特定的示例，第三人承诺可能是“我的助理John今天晚些时候会向您报告”。

[0047] 在一些示例中，任务提取过程204可以至少部分地基于消息(例如，诸如电子邮件线程)的作者或与消息的内容相关联的人员(例如，诸如在消息中所提及的人员)之间或其之中的个人和/或职业关系，从电子通信202(诸如消息)中提取任务内容。任务提取过程204还可以至少部分地基于消息的作者或与消息的内容相关联的人员之间或其之中的先前通信，从消息中提取任务内容。

[0048] 在一些示例中，任务提取过程204可以(i)分析电子通信202的内容以及(ii)实时自动从电子通信的内容中提取请求或者承诺。例如，在任务提取过程204期间，执行任务提取过程的系统，可以通过向用户通知可能的时间冲突或其他承诺，来立即要求关于承诺的确认和/或向用户提供实时支持，以防止用户过度承诺。在特定的示例中，系统可以用来协助时间管理，并且通过显示消息“你可能不能这样做，你本周已经承诺太多事情”，来通知用户超载。

[0049] 图3是图示了包括示例文本线程和请求或承诺的任务提取过程304的电子通信302的框图。例如，作为来自另一用户的、在用户的计算设备上接收的对用户的文本消息的通信302，包括来自其他用户的文本306和来自用户的文本308。任务提取过程304包括分析通信302的内容(例如，文本306和文本308)以及确定(i)用户或其他用户的承诺和/或(ii)用户或其他用户的请求。在图3中图示的示例中，其他用户的文本306包括用户在5月9日帮助建立Alexis的生日派对的请求310。用户的文本308包括用户打算在5月9日下午3点帮助建立Alexis的生日派对的承诺312。任务提取过程304可以通过涉及分析文本306和文本308的若干种技术中的任一技术，来确定请求和承诺。在一些实现方式中，如果文本不足以确定请求或承诺(例如，“缺失的”信息或高度不确定的信息)，则任务提取过程304可以查询若干个数据源中的任一数据源。例如，如果文本306不包括Alexis的生日派对的日期(例如，其他用户可以假设用户记住日期)，则任务提取过程304可以针对生日日期，来查询用户或其他用户的日历。

[0050] 在各种示例中，任务提取过程304可以确定传入或传出消息(例如电子邮件、文本等)包含意图用于接收者/发送者或者由该接收者/发送者而意图的请求或承诺的似然性(例如，推断的可能性)或其他置信度度量。这样的置信度或似然性可以至少部分地由消息的一个或多个部件或者部件的概括是有效的请求或承诺的所计算的概率而被确定。

[0051] 在一些示例中，任务提取过程304可以确定承诺的置信度度量，其中低置信度承诺是用户很可能不履行承诺的承诺，并且高置信度承诺是用户很有可能履行承诺的承诺。例如，似然性(例如概率)或其他置信度度量可以被用来捕获某一任务提取过程304是如何至少部分地基于使用统计分类器而关于提取的承诺。承诺的置信度可以用于后续服务，诸如

提醒、待办事项列表的修订、约定、会议请求和其他时间管理活动。确定承诺的置信度可以至少部分地基于用户的事件的历史(例如,过去承诺等的跟进动作)和/或其他用户的事件的历史和/或用户或另一用户的个人信息(例如,年龄、性别、年龄、职业、经常旅行者等)。例如,任务提取过程304可以查询这样的历史。在一些实现方式中,在任务提取过程304可以查询用户的个人信息之前,用户中的任一或全部必须"选中"或采取其他肯定动作。如果这样的历史表明用户例如已经出席Alexis的最近几个生日、用户倾向于出席许多其他人员的生日、用户与Alexis和/或其他用户具有相对密切关系等,则任务提取过程304可以为用户的承诺指派相对较高的置信度。确定承诺的置信度还可以至少部分地基于文本306和/或文本308中的关键词或术语。例如,"生日派对"通常具有积极和合意的意义(例如,与工作任务相反的派对),从而使得承诺可能会比较强。另一方面,在涉及编写会计报告的承诺的另一示例中,这样的活动通常是不合意的,因此这样的承诺可能被指派相对较低的置信度。然而,如果这种编写会计报告的承诺与用户的工作(例如,职业)相关联,那么这种承诺可以被指派相对较高的置信度。任务提取过程304可以对若干种这样的场景和因素加权,以确定承诺的置信度。例如,任务提取过程304可以至少部分地基于与电子消息有关的内容,确定消息中的请求或者承诺的置信度(例如,重要性)。

[0052] 图4是消息与任务内容中的示例关系的表400。特别地,这样的任务内容包括承诺和/或请求,这些承诺和/或请求中的任一个可以由计算设备或"其他用户实体"的用户而生成(例如,由应用自动生成或由应用手动编写),该其他用户实体可以是一个或多个计算设备上的一个或多个人员。在一些示例中,其他用户实体可以是可以向他自己或她自己发送消息的用户。在其他示例中,用户和/或其他用户实体可以是任何人(例如委托人、助理、主管等)或机器(例如被配置成接收和执行指令的基于处理器的系统)。表400图示了由计算设备的用户生成的并且发送到其他用户实体的传出消息,以及由其他用户实体生成的并且由计算设备的用户接收的传入消息。

[0053] 可以从传出消息或传入消息中提取的承诺的示例包括:"我将准备文件并且在星期一寄给您"、"我将在星期五之前把支票寄给史密斯先生"、"我会做的"、"我将回到您身边"、"将要做"等。后面的示例表明承诺(或其陈述)不需要包括时间或期限。可以从传入消息或传出消息中,提取请求的示例包括:"您能确保把钥匙放在垫子下面吗?"、"让我知道您是否可以早点吃晚饭"、"你月底之前能完成预算分析吗?"等。请求不一定是直接问题的形式。例如,"不要忘记在下午5点前拿到您的报告"不是个直接问题,但这个陈述提出了要求。

[0054] 表400包括消息中所包括的任务的4个特定情况。一种情况是传出消息,其包括用户对其他用户实体的承诺。另一种情况是传出消息,其包括用户对其他用户实体的请求。又一情况是传入消息,其包括来自其他用户实体对用户的承诺。又一情况是传入消息,其包括来自其他用户实体对用户的请求。用于从消息中提取任务内容的过程至少部分取决于正在处理哪个特定情况而可能彼此不同。这样的过程可以由用户的计算设备或与计算设备通信的计算系统(例如,服务器)来执行。例如,被应用于传入消息包括来自其他用户实体对用户的承诺的情况的过程,可以涉及查询各种数据源,以确定其他用户实体的承诺的置信度(例如诚意、可靠性、值得)。这样的各种数据源可以包括其他用户实体的个人数据或历史。在一些示例中,数据源可以是与设备的处理部件相关联的存储器,诸如经由总线电子地耦合到处理器的存储器设备。在一些示例中,其他用户实体的动作的历史(取消会议或未能通过任

务跟进)可以指示其他用户实体的承诺的可靠性。在一些实现方式中,在过程可以访问用户和/或其他用户实体的个人信息之前,用户和/或其他用户实体必须“选中”或采取其他肯定动作。

[0055] 作为另一示例,被应用于传出消息包括用户对其他用户实体的请求的情况的过程,可以涉及查询各种数据源,以确定用对用户的请求的强烈(例如诚意的、可靠的、值得的)承诺做出响应的其他用户实体的结果的似然性。这样的各种数据源(其不需要处在执行该过程的一个或多个设备的外部)可以包括其他用户实体的个人数据或历史。例如,其他用户实体的行动(取消会议或未能通过任务跟进)的历史可以指示其他用户实体将接受或跟进对用户的请求的承诺的似然性(或者,似然性的缺乏)。

[0056] 另一方面,被应用于传入消息包括来自其他用户实体对用户的请求的情况的过程,可以涉及查询各种数据源,以确定请求的重要性(并且随之,确定对请求的承诺的重要性)。例如,如果其他用户实体是用户的主管,则该请求可能是相对重要的。因而,该过程可以查询包括其他用户实体的个人和/或专业数据的各种数据源,以确定其他用户实体是主管、下属、同事、朋友、家庭等。

[0057] 在另一示例中,被应用于传出消息包括用户对其他用户实体的承诺的情况的过程,可以涉及查询各种数据源,以确定承诺的重要性。例如,如果其他用户实体是用户的主管,那么承诺可能是相对重要的。因而,该过程可以查询包括其他用户实体的个人和/或专业数据的各种数据源,以确定其他用户实体是主管、下属、同事、朋友、家庭等。

[0058] 图5是包括与若干个实体504至518进行通信的提取模块502的示例系统500的框图。仅作为几个示例,这些实体可以包括主机应用(例如互联网浏览器、SMS文本编辑器、电子邮件应用、电子日历功能等)、数据库或信息源(例如个人的个人历史、企业或机构的组织信息、可能提供数据作为服务的第三方数据聚集器等)。例如,提取模块502可以与图1所图示的计算设备102中的提取模块116相似。诸如(仅举几个)训练数据510、日历512以及从社交媒体516收集的数据的实体中的一些实体504至518,可以被存储在与提取模块502相关联的存储器设备中。例如,存储器设备可以被直接连接(例如,以有线方式)到提取模块502(例如,该模块可以是处理部件)。在另一示例中,存储器设备可以无线和/或远程(例如,通过一个或多个远程对等计算设备、远程服务器或者分布式计算资源,例如经由云计算)而被连接到提取模块502。

[0059] 提取模块502可以被配置成通过应用若干种语言分析技术中的任一个来分析由实体504至518提供的通信内容和/或数据或信息。例如,提取模块502可以被配置成分析由电子邮件实体504、SMS文本消息实体506等提供的通信的内容。提取模块502还可以被配置成分析由因特网实体508、提供训练数据510的机器学习实体、电子邮件实体504、日历实体512等提供的数据或信息。提取模块502可以通过将语言分析应用于从实体504至518中的任一实体收集的信息或数据,来分析内容。

[0060] 图5中的双端箭头指示数据或信息可以在实体504至518和提取模块502之中沿任一方向流动。例如,从提取模块502流到实体504至518中的任一实体的数据或信息,可以是由提取模块生成的查询的一部分,以便查询实体。提取模块502可以使用这样的查询,来确定由实体中的任一实体提供的内容的一个或多个含义。

[0061] 在一些示例中,提取模块502可以从电子邮件实体504接收多个用户中的电子邮件

交换(例如通信)的内容。提取模块可以分析内容,以确定内容的一个或多个含义。分析内容可以通过若干种技术中的任一种来执行,以确定内容的元素的含义,该元素诸如单词、短语、句子、元数据(例如电子邮件的大小、创建的日期等)、图像以及如何以及是否与这样的元素相关联。内容的“含义”可能是人们将如何以自然语言解释内容。例如,内容的含义可以包括人员执行任务的请求。在另一示例中,内容的含义可以包括任务的描述、任务应当何时完成的时间、关于任务的背景信息等。

[0062] 在可选的实现方式中,例如提取模块可以查询诸如例如社交媒体实体516之类的一个或多个数据源的内容。一个或多个数据源的这种内容可以与电子邮件交换的内容有关(例如按主题、作者、日期、时间、位置等有关)。至少部分基于(i)电子邮件交换的内容的一个或多个含义以及(ii)一个或多个数据源的内容,提取模块502可以从电子邮件交换的内容中自动提取请求或承诺。

[0063] 在一些示例中,提取模块502可以使用从训练数据510和/或从提取模块与实体504至518中的任一实体中的实时进行的通信而学习到的预测模型中,提取任务内容。这种预测模型可以推断传出或传入通信(例如消息)或通信的内容包含请求。类似地,传出或传入通信或通信内容可能包含执行任务的承诺。标识和提取来自传入或传出通信的承诺和要求可以服务多种功能,该多种功能支持关于承诺和要求的通信的发送者和接收者。

[0064] 在一些示例中,仅作为几个示例,提取模块502可以使用统计模型提取任务内容,以标识和提取来自从电子邮件实体504接收的电子邮件或SMS文本消息实体506的SMS文本消息的承诺和请求的提议和确认。统计模型可以至少部分地基于来自实体504至518中的任一实体或组合的数据或信息。

[0065] 在一些示例中,提取模块502可以在消息的作者编写消息的同时,提取任务内容。例如,这样的编写可以包括使用任何类型的文本编辑器或应用来输入电子邮件或文本消息。在其他示例中,提取模块502可以在人员读取所接收到的消息的同时,提取任务内容。例如,当人员读取消息时,提取模块502可以通过突出显示或强调消息文本中的请求或承诺,来注释消息的部分。在一些实现方式中,提取模块可以在读取(或显示)消息期间,将相关信息添加到消息。例如,这样的相关信息可以从其他数据源或信息(诸如从实体504至518)而被推断。在特定的示例中,计算机系统可以显示包括读者出席课程类型的请求的消息。提取模块502可以查询因特网508,以确定在读者所驻留的区域(例如,其可以从关于读者的个人数据中而推断出)中的各个位置和一天中的各个时间提供若干个这样的课程。因而,提取模块可以生成选择或建议的列表并且将其提供给读者。例如,这样的列表可以响应于鼠标悬停而显示在文本的相关部分的文本附近,或者可以“永久地”显示在显示器的其他部分中。在一些实现方式中,列表可以包括可由读者选择(例如,通过鼠标点击)的项目,以使得请求将包括由读者选择的时间(该时间可以替代请求者“建议”的时间,并且可以将读者所选择的时间自动通知给请求者)。

[0066] 图6是可以对诸如音频记录、图像或视频记录之类的非文本内容604执行任务提取的示例提取模块602的框图。提取模块602可以与图5中所图示的提取模块502相同或相似。例如,提取模块602可以与实体504至518中的任一或全部实体进行通信。

[0067] 非文本内容604可以被转换成描述非文本内容的元素的对应文本606。例如,若干种图像识别技术中的任一种可以被用来将图像(或视频记录的静态图像)转换成文本。类似

地，若干种音频到文本技术中的任一种可以被用来经音频记录转换成文本。对应文本606可以被提供给提取模块602，该提取模块602随后可以从对应文本中提取任务内容。例如，这种提取的任务内容可以包括承诺608和/或请求610。

[0068] 说明提取模块602如何从非文本内容604而提取任务内容的特定说明性示例，涉及包括气球和飘带的图像的消息。这样的图像可以通过识别气球和飘带的图像并且生成文本“气球”和“飘带”的图像识别技术，而被转换成文本606。可以包括附加文本来描述图像中的气球和飘带之中的并列关系。提取模块602可以查询若干个实体(例如，504至518)中的任一个，以确定气球和飘带相对于消息的发送者的上下文。在一个示例中，提取模块602可以确定(例如，通过搜索发送者和因特网站点之间的匹配)该消息是用于派对用品的广告。作为结果，提取模块可以推论该消息不包括承诺或请求。在另一示例中，提取模块602可以确定(例如，通过搜索关于发送者和消息接收者的个人信息)该消息是关于生日派对的通知(例如，诸如如果发送者或任何家庭成员有生日即将到来，或者接收者过去几年都参加过这样的生日等)。在这样的情况下，提取模块602可以认为图像是针对接收者出席生日派对的请求。附加地，提取模块可以推断该聚会的日期，并且相应地生成包括任务和执行该任务的时间的完整请求。

[0069] 在一些示例中，由提取模块602(或502)执行的任务提取过程可以使消息发送者和/或接收者参与，以确认由提取模块提取的承诺或请求的正确性。特别地，如果提取模块602以相对较低的置信度执行推断(例如，基于模糊或者松散相关的信息的推断)，则提取模块可以针对关于消息中的任务的附加信息或确认而提示发送者和/或接收者。另一方面，如果提取模块602以相对高的置信度执行推断(例如，基于固定或紧密相关的信息的推断)，则提取模块不需要针对关于消息中的任务的附加信息或确认而提示发送者和/或接收者。

[0070] 在一些示例中，提取模块602可以被配置成执行非文本内容到对应文本的转换。在其他示例中，提取模块602可以被配置成仅接收已经从非文本内容转换的对应文本。

[0071] 图7是根据各种示例的机器学习系统700的框图。机器学习系统700包括机器学习模型702(其可以与图1中所图示的机器学习模块114相似或相同)、训练模块704和提取模块706，该提取模块例如可以与提取模块502相同或相似。虽然被图示为分离的框，但是在一些示例中，提取模块706可以包括机器学习模型702。机器学习模型702可以从离线训练模块704接收训练数据。例如，训练数据可以包括来自包括机器学习系统700的计算系统的存储器的数据或者来自图5中所图示的实体502至518的任何组合的数据。存储器可以存储由计算系统或特定用户接收的请求和承诺的历史和/或发送到计算系统或特定用户的请求和承诺的历史。来自存储器或实体的数据可以用来训练机器学习模型702。在这样的训练之后，机器学习模型702可以由提取模块706采用。因此，作为示例，使用来自针对离线训练的请求和/或承诺的历史的数据的训练可以充当机器学习模型的初始条件。可以使用其他训练技术，诸如下文所描述的涉及特征化的那些训练技术。

[0072] 图8是根据各种示例的机器学习模型800的框图。机器学习模型800可以与图7所示的机器学习模型702相同或相似。机器学习模型800包括若干个功能块中的任一个，诸如随机森林块802、支持向量机块804和图模型块806。随机森林块802可以包括用于分类的总体学习方法，其通过在训练时间构造决策树来操作。例如，随机森林块802可以输出作为由个别树输出的类的模式的类。随机森林块802可以用作包括几个可互换部分的框架，其可以被

混合和匹配以创建大量的特定模型。在这样的框架中构造机器学习模型涉及确定每个节点中使用的决策的方向、确定每个叶中使用的预测器的类型、确定每个节点中优化的分割目标、确定向树中注入随机性的方法等。

[0073] 支持向量机模块框804针对机器学习模型800的数据进行分类。支持向量机模块框804可以用作具有分析数据和识别模式的相关联的学习算法的监督学习模型，该学习算法被用于分类和回归分析。例如，给定训练数据集合的情况下，每个训练数据被标记为属于两个类别中的一个，支持向量机训练算法构建机器学习模型，该学习模型将新的训练数据指派到一个类别或其他类别。

[0074] 图模型框806用作概率模型，针对该模型，图是示出随机变量之间的条件依赖性和独立性的概率图模型。概率图模型表示感兴趣变量集合上的联合概率分布。概率推断算法对这些图模型进行操作，以基于特定证据来执行推断。推论提供关于感兴趣概率(诸如消息或特定句子包含承诺或请求的概率)的更新。学习过程可以利用从非结构化信息的训练集合中发现结构的过程，从数据构造这样的概率模型。学习过程还可以从来自用户的显式反馈(例如，确认所提取的任务信息是否正确)构造这样的概率模型。仅作为几个示例，可以被用来从非文本内容推断任务内容的图模型的应用可以包括信息提取、语音识别、图像识别、计算机视觉以及低密度奇偶校验码的解码。

[0075] 图9是图示了提交和请求提取中涉及的示例在线和离线过程900的框图。这样的过程可以由处理器(例如，处理单元)或诸如上文所描述的计算设备102之类的计算设备来执行。“离线”是指训练阶段，其中使用监督/标记训练数据(例如，标记有承诺和请求句子的电子邮件集合)来训练机器学习算法。“在线”是指已经被训练以从新的(未见过的)电子邮件中提取承诺和请求的模型的应用。特征化过程902和模型学习过程904可以由计算设备离线或在线执行。另一方面，接收新消息906和应用模型的过程908可以在线发生。

[0076] 在一些示例中，特征化过程902、模型学习过程904和应用模型的过程908中的任一或全部可以由诸如提取模块116或502之类的提取模块执行。在其他示例中，特征化过程902和/或模型学习过程904可以由机器学习模块(例如，图1中所图示的机器学习模块114)执行，并且应用模型的过程908可以由提取模块执行。

[0077] 在一些示例中，特征化过程902可以从诸如图5中所图示的实体504至518中的任一实体的各种源中接收训练数据910和数据912。特征化过程902可以生成有助于分类的文本片段的特征集合。文本片段可以包括一个或多个通信的内容的部分(例如，训练数据910的通常相对大量的通信)。例如，文本片段可以是单词、术语、短语或其组合。模型学习过程904是机器学习过程，其生成并且迭代地改进在过程908中使用的模型，以从通信中提取任务内容，诸如请求和承诺。例如，该模型可以被应用于新的消息906(例如，电子邮件、文本等)。计算设备可以连续地、不时地或者周期性地、异步地从将模型应用于新消息906的过程908而执行模型学习过程904。因此，作为示例，模型学习过程904可以更新或改进模型离线并且模型学习过程904与在线过程无关，诸如将模型(或模型的当前版本)应用于消息906。

[0078] 将模型应用于新消息906的过程908可以涉及考虑可以从诸如上文所描述的504至518的实体接收的其他信息914。在一些实现方式中，来自其他源的数据912的至少一部分可以与其他信息914相同。应用模型的过程908可以导致提取新消息906中包括的任务内容。这种任务内容可以包括承诺和/或请求。

[0079] 图10是可以由提取模块或处理器(例如,处理单元)执行的示例任务提取过程1000的流程图。例如,过程1000可以由图1所图示的计算设备102(例如,提取模块116)执行,或者更特定地,在其他示例中,可以由图5中所图示的提取模块502来执行。

[0080] 在框1002,提取模块可以分析电子通信的内容,以确定内容的一个或多个含义。例如,这样的电子通信可以包括电子邮件、文本消息、非文本内容、社交媒体发布等。在框1004,提取模块可以查询与电子通信有关的一个或多个数据源的内容。例如,一个或多个数据源可以包括在图5的示例中描述的实体504至518中的任一个。在另一示例中,对于提取模块116是提取模块116而言,一个或多个数据源可以包括在图1的示例中描述的计算机可读介质108的任何部分。仅作为几个示例,一个或多个数据源可以与主题的电子通信、电子通信的作者、与作者有关的人员、时间、日期、事件的历史以及组织有关。

[0081] 在框1006,提取模块可以自动从内容提取请求或承诺。这样的提取可以至少部分地基于(i)内容的一个或多个含义以及(ii)一个或多个数据源的内容。

[0082] 在一些实现方式中,电子通信包括音频、图像或视频。转换模块可以用于将音频、图像或视频转换为对应文本,以生成电子通信的内容。电子通信的内容可以被提供给提取模块。

[0083] 在一些实现方式中,提取模块可以实时执行过程1000。

[0084] 图10中所示的操作流可以被图示为表示可以以硬件、软件、固件或其组合实现的操作的顺序的框和/或箭头的集合。描述各框的顺序并不旨在被解释为限制性的,并且任何数目个描述的操作可以以任何次序被组合,以实现一种或多种方法或可选方法。附加地,在不背离本文中所描述的主题的精神和范围的情况下,可以从操作流程中省略各个操作。在软件上下文中,框表示计算机可读指令,在该计算机可读指令由一个或多个处理器执行时,配置处理器以执行所描述的操作。在硬件上下文中,框可以表示被配置成执行所描述的操作的一个或多个电路(例如,FPGA、专用集成电路(ASIC)等)。

[0085] 图10中所图示的操作流中的任何例程描述、元件或框可以表示包括用于实现例程中的特定逻辑功能单元的一个或多个可执行指令的代码的模块、片断或部分。

[0086] 示例条款

[0087] A.一种系统,其包括:接收端口,其用于接收电子通信的内容;以及提取模块,其用于分析内容以确定电子通信的内容的一个或多个含义;查询与电子通信有关的一个或多个数据源的内容;以及至少部分地基于(i)内容的一个或多个含义和(ii)一个或多个数据源的内容,从内容中自动提取请求或者承诺。

[0088] B.如段落A所阐述的系统,其中一个或多个数据源的内容包括电子通信的内容的一个或多个作者的个人数据。

[0089] C.如段落A所阐述的系统,其中电子通信包括音频、图像或视频,并且还包括转换模块,其用于将音频、图像或视频转换成对应文本,以生成电子通信的内容;以及将该电子通信的内容提供给提取模块。

[0090] D.如段落A所阐述的系统,其中提取模块被配置成通过将统计模型应用于电子通信的内容,分析电子通信的内容。

[0091] E.如段落A所阐述的系统,其中提取模块被配置成利用所提取的请求或承诺相关联的人员的标识和一个或多个位置,来扩充所提取的请求或承诺。

[0092] F.如段落A所阐述的系统，进一步包括机器学习模块，其被配置成将电子通信的内容和/或一个或多个数据源的内容用作训练数据。

[0093] G.如段落A所阐述的系统，其中提取模块被配置成(i)分析电子通信的内容以及(ii)实时自动从电子通信的内容中提取请求或承诺。

[0094] H.一种方法，其包括：接收消息；将语言分析应用于消息，以将消息自动转换成机器语言特征；针对与该消息有关的信息来搜索数据源；从数据源接收与消息有关的信息；以及至少部分地基于所接收的信息，自动标识机器语言特征中的请求或承诺。

[0095] I.如段落H所阐述的方法，其中消息包括音频、图像或视频，并且其中将语言分析应用于消息还包括：确定与音频、图像或视频相对应的文本；以及将语言分析应用于与音频、图像或视频相对应的文本。

[0096] J.如H段所阐述的方法，其中与消息有关的数据源包括其他消息。

[0097] K.如段落H所阐述的方法，其中与消息有关的数据源包括消息的作者的一个或多个方面。

[0098] L.如段落H所阐述的方法，其中接收消息还包括：在一个时间间隔期间，顺序地接收消息的各部分；以及在时间间隔期间，将语言分析应用于消息的所接收的部分。

[0099] M.如段落H所阐述的方法还包括：将消息标记和/或注释为包含请求或承诺。

[0100] N.一种计算设备，包括收发器端口，其用于接收和发送数据；以及处理器，其用于分析由用户经由用户接口而输入的电子消息；针对与电子消息有关的内容来搜索数据；以及至少部分地基于与电子消息有关的内容，从电子消息中提取与请求或承诺相对应的文本。

[0101] O.如段落N所阐述的计算设备，其中处理器被配置成至少部分地基于与电子消息有关的内容，确定请求或者承诺的重要性。

[0102] P.根据段落N所阐述的计算设备，其中处理器被配置成将电子消息或数据作为训练数据，应用于机器学习过程。

[0103] Q.如段落P所阐述的计算设备，其中分析电子消息是由机器学习过程执行的。

[0104] R.如段落N所阐述的计算设备，其进一步包括电子显示器，并且其中处理器还被配置成生成要在电子显示器上显示的图像，其中图像包括用于用户确认与请求或承诺相对应的文本是否准确或真实的提示。

[0105] S.如段落N所阐述的计算设备，其中处理器还被配置成分析电子消息的参数，其中参数包括以下各项中的一项或多项：个别电子信息的接收者数目、长度、日期与时间以及主题报头。

[0106] T.如段落N所阐述的计算设备，其中处理器还被配置成在用户输入电子消息的同时，分析关于用户的信息。

[0107] 尽管已经以特定于结构特征和/或方法动作的语言描述技术，但是应当理解，所附权利要求不一定限于所描述的特征或动作。相反，这些特征和动作仅仅被描述为这种技术的示例实现方式。

[0108] 除非另有说明，否则上文描述的所有方法和过程可以全部或部分地由一个或多个通用计算机或处理器执行的软件代码模块来实现。代码模块可以存储在任何类型的计算机可读存储介质或其他计算机存储设备中。方法中的部分或全部可以可替换地全部或部分由

专用计算机硬件(诸如FPGA、ASIC等)来实现。

[0109] 除非另有明确说明,否则除其他之外,诸如“可以”、“可能会”、“可能”或“可能是”之类的条件语言,被用于指示某些示例包括而其他示例不包括所指出的特征、元素和/或步骤。因此,除非另有说明,否则无论如何这样的条件语言都不旨在暗示特征、元件和/或步骤都是针对一个或多个实施例所必需的,也不旨在暗示一个或多个实施例,无论在有无用户输入或提示的情况下,都必然包括用于确定这些特征、元件和/或步骤是否被包括在任何特定示例中或者是否要在该特定示例中执行这些特征、元件和/或步骤的逻辑。

[0110] 除非另有特别说明,否则诸如短语“X,Y或Z中的至少一个”之类的连接语,应被理解为呈现项目、术语等可以是X、或Y、或Z,或其组合。

[0111] 可以对上文所述的示例做出多种变化和修改,该示例的元件被理解为处在其他可接受的示例之中。所有这样的修改和变化旨在包括在本公开的范围内。

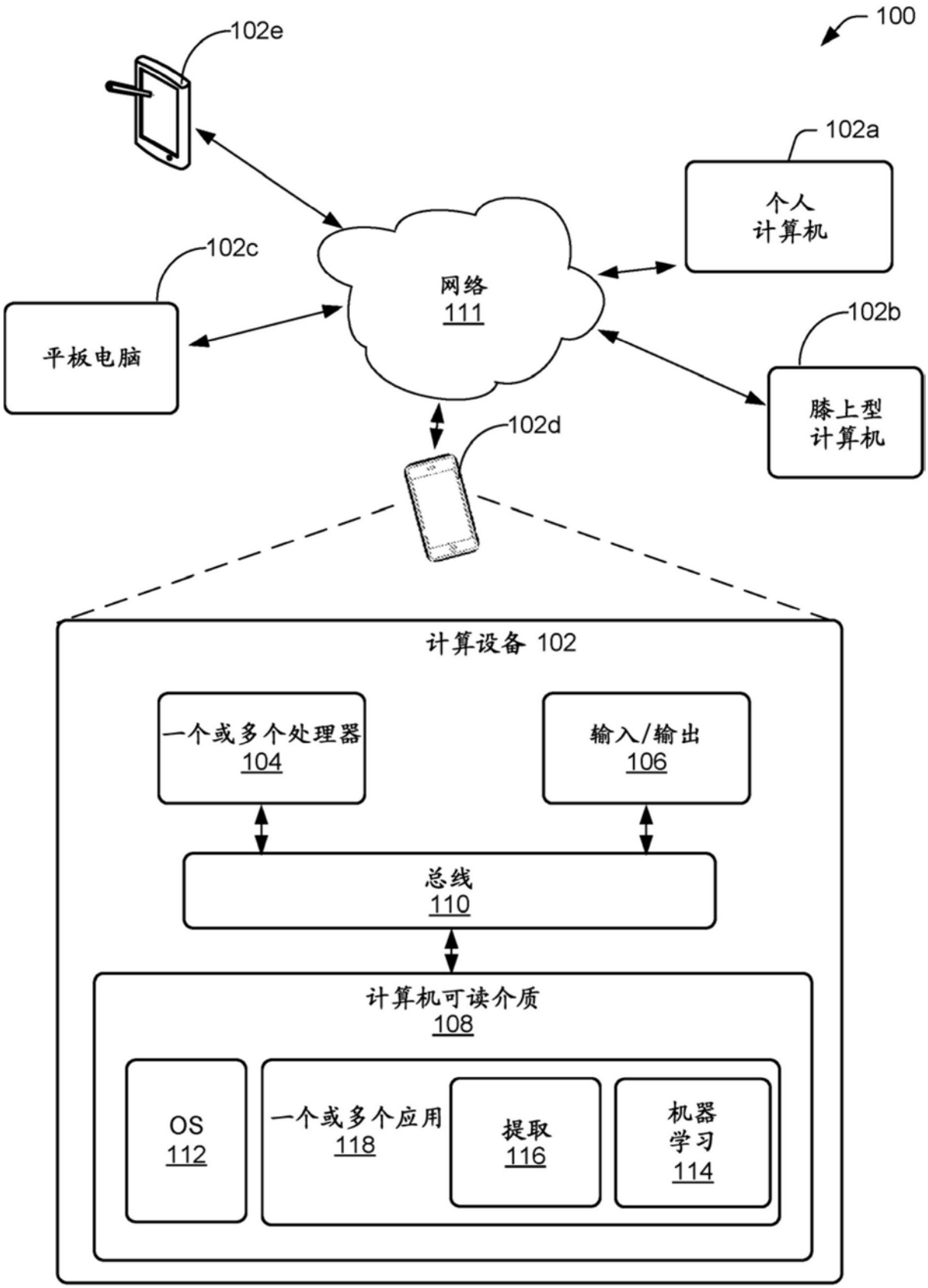

100
102e
102a
个人
计算机
102c
网络
111
102b
平板电脑
膝上型
计算机
102d
计算设备 102
一个或多个处理器
104
输入/输出
106
总线
110
计算机可读介质
108
OS
112
一个或多个应用
118
提取
116
机器
学习
114

图1

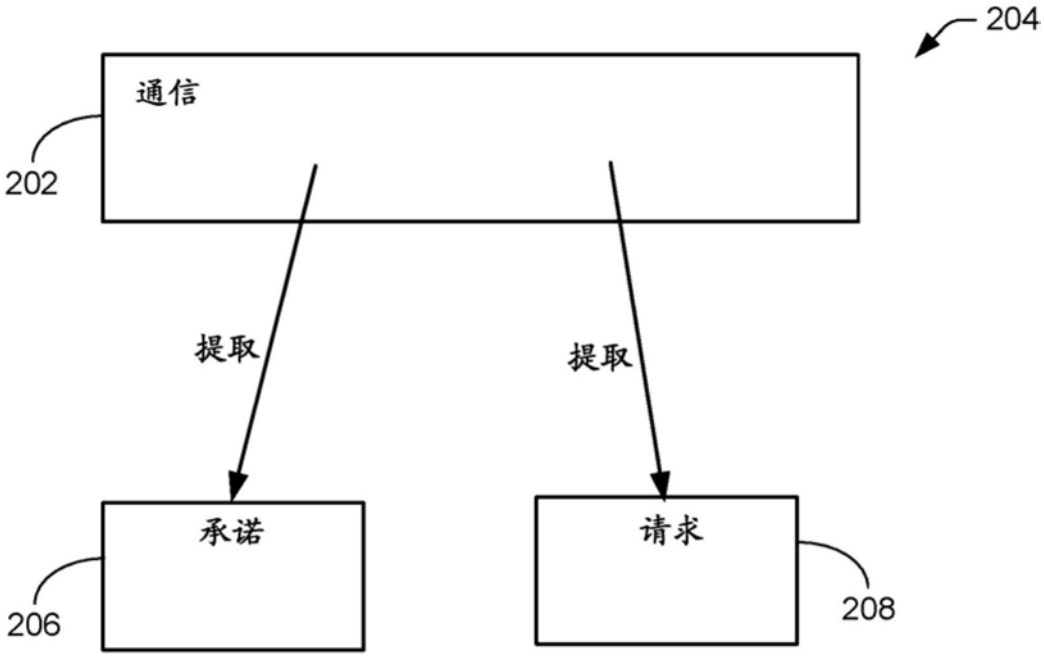


图2

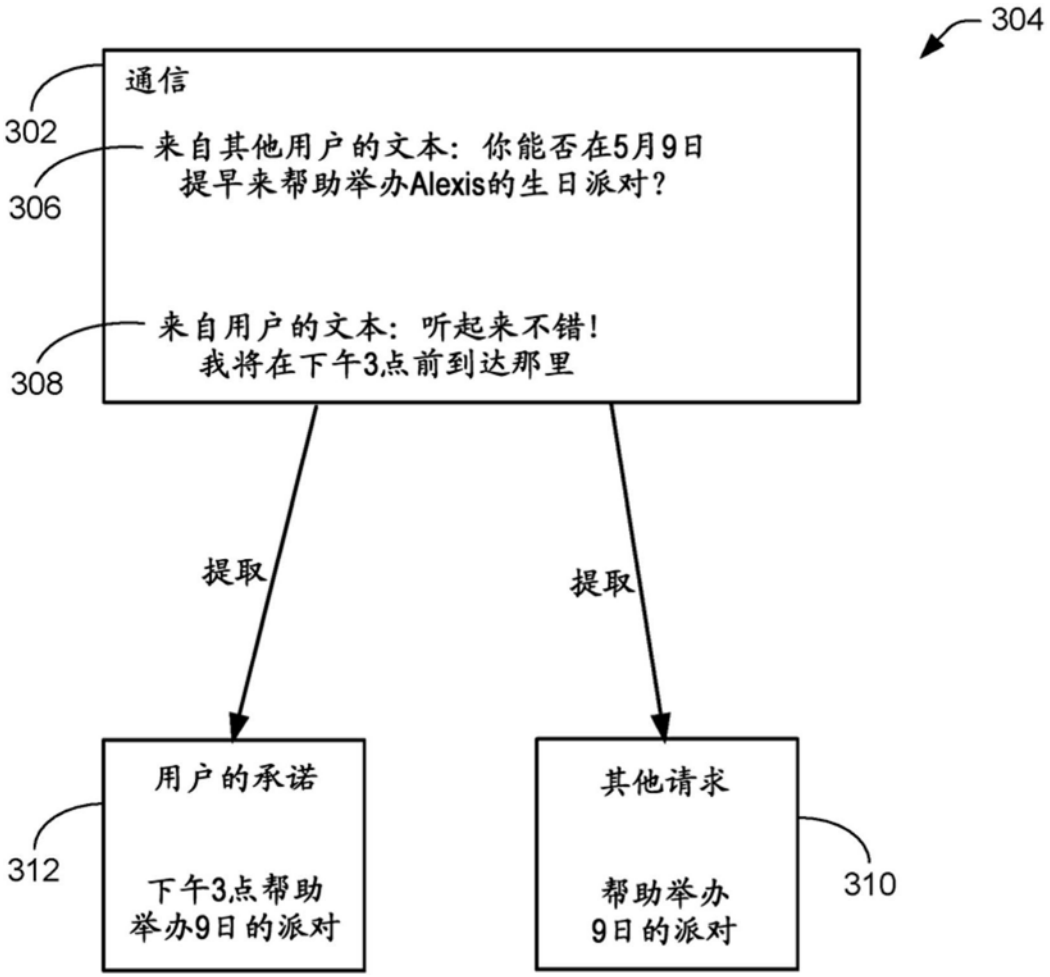

304
通信
302
来自其他用户的文本：你能否在5月9日提早来帮助举办Alexis的生日派对？
306
来自用户的文本：听起来不错！我将在下午3点前到达那里
308
提取
提取
用户的承诺
下午3点帮助举办9日的派对
312
其他请求
帮助举办9日的派对
310

图3


400
承诺
请求
传出消息
用户对其他人的承诺
用户对其他人的请求
传入消息
其他人对用户的承诺
其他人对用户的请求

图4

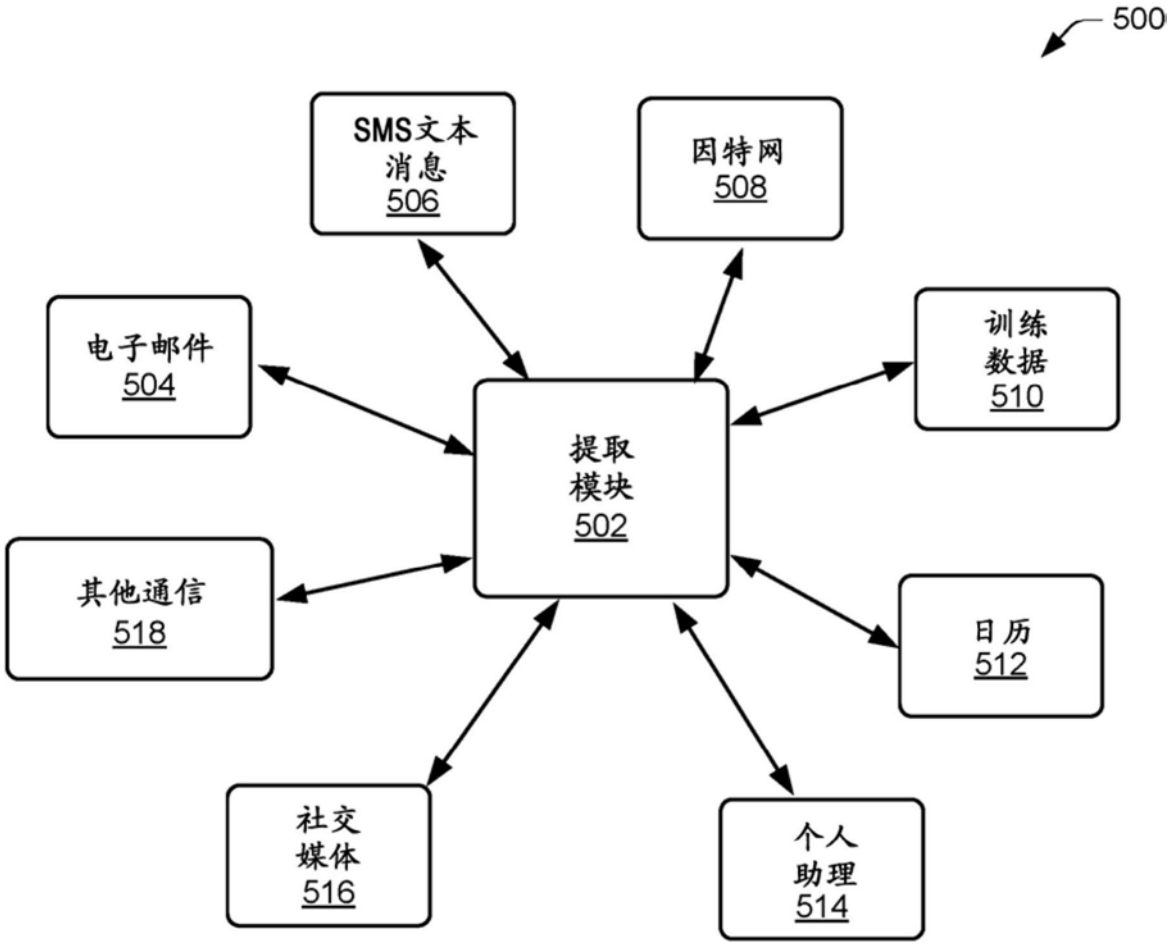

500
SMS文本消息 506
因特网 508
电子邮件 504
训练数据 510
提取模块 502
其他通信 518
日历 512
社交媒体 516
个人助理 514

图5

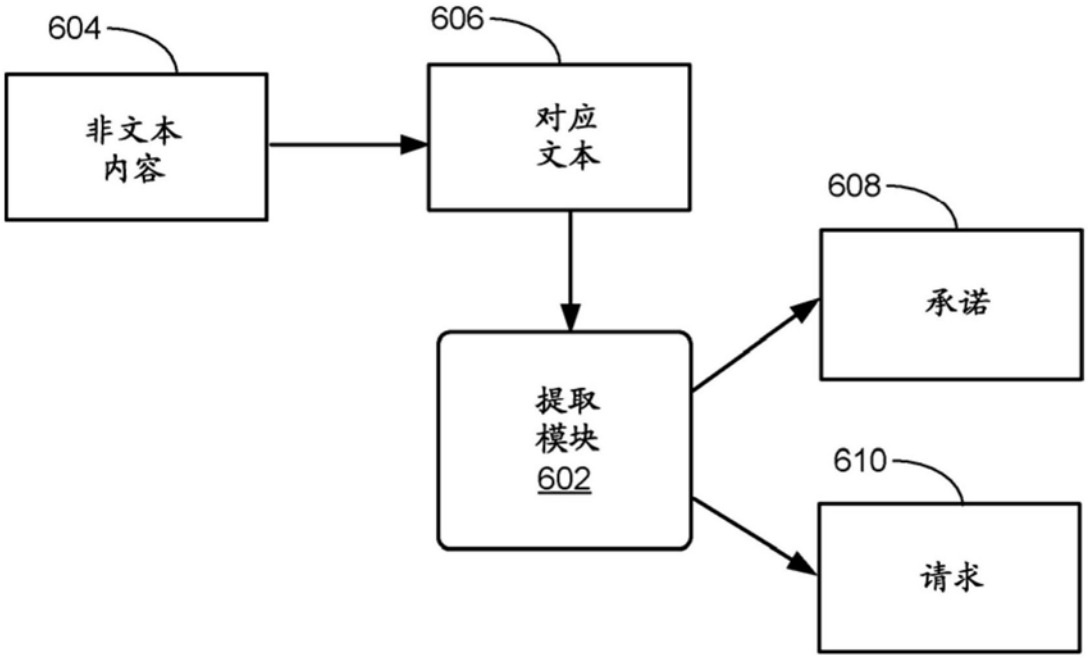

604
非文本内容
606
对应文本
608
承诺
提取模块 602
610
请求

图6

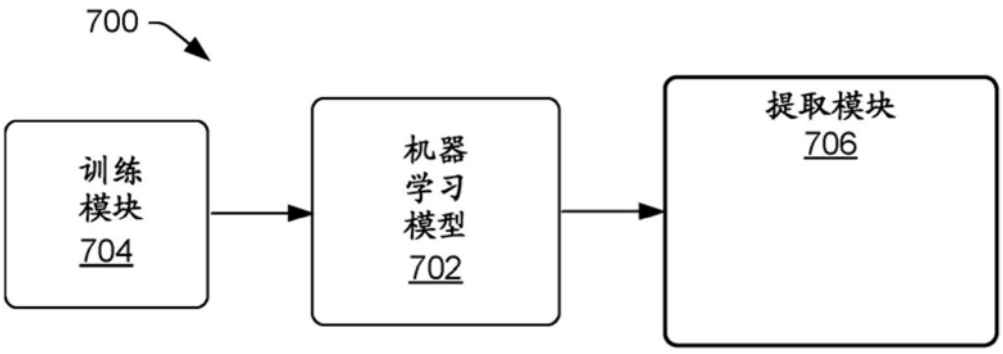

700
训练
模块
704
机器
学习
模型
702
提取模块
706

图7

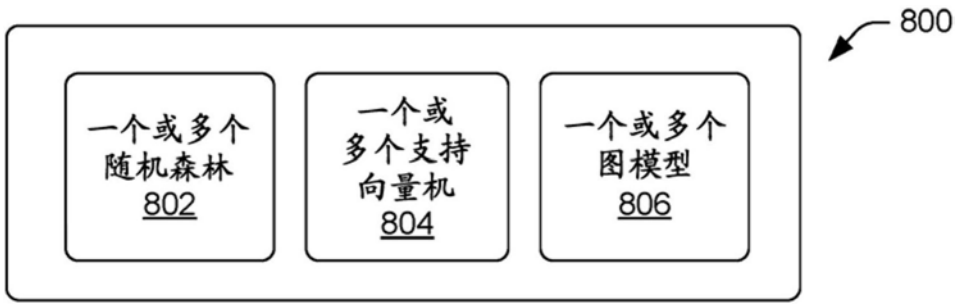

800
一个或多个
随机森林
802
一个或
多个支持
向量机
804
一个或多个
图模型
806

图8

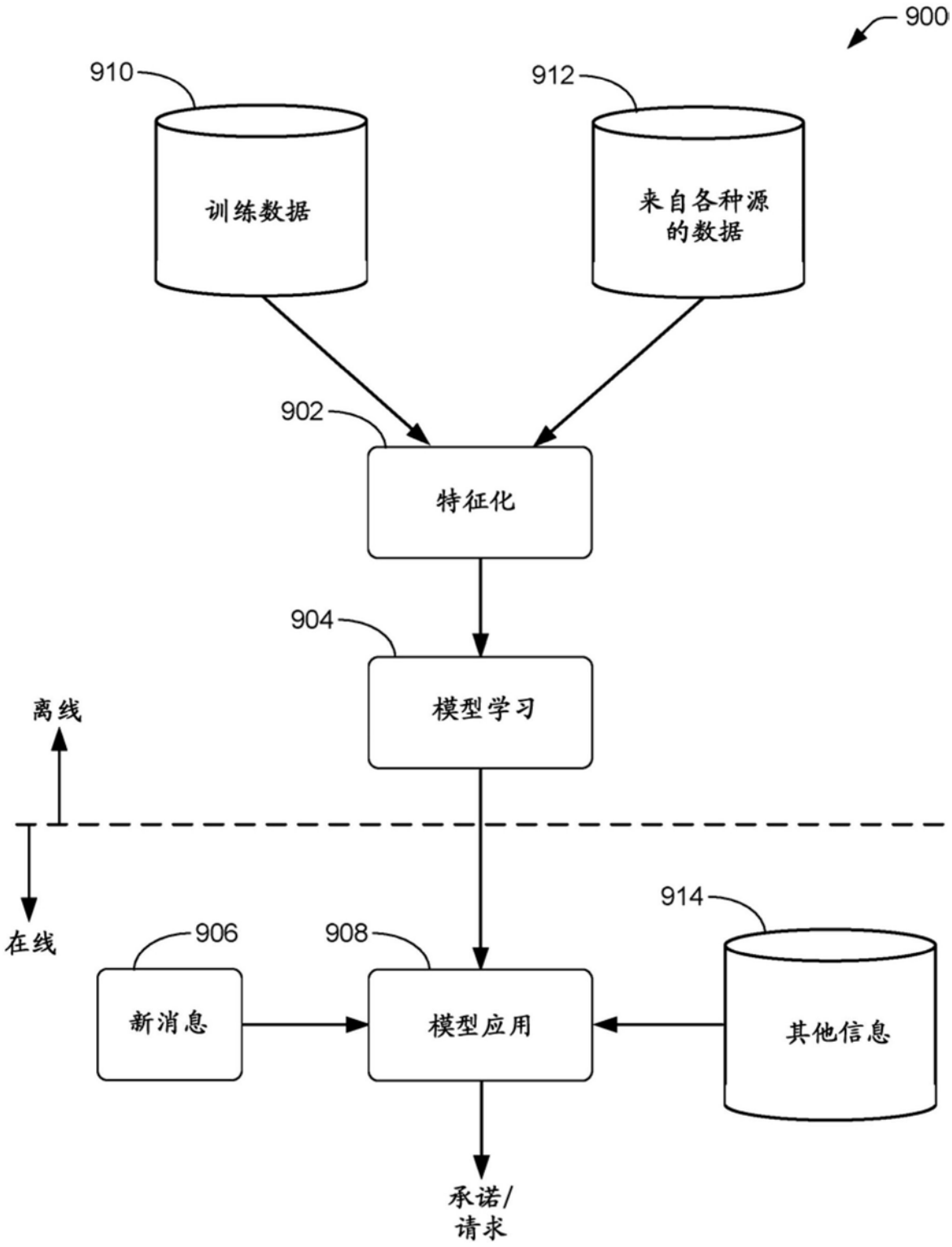

900
910
训练数据
912
来自各种源的数据
902
特征化
904
模型学习
离线
在线
906
新消息
908
模型应用
914
其他信息
承诺/请求

图9

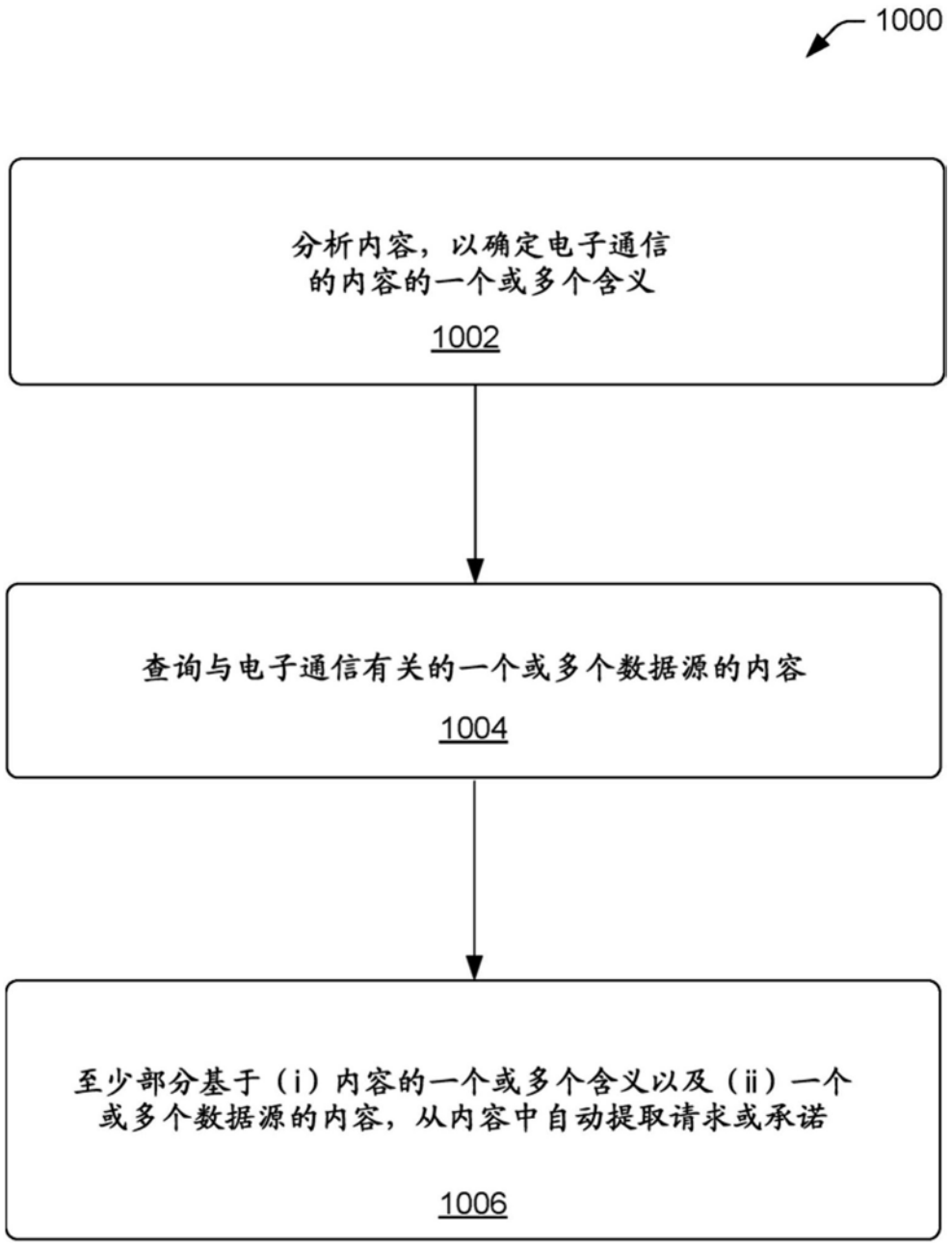

1000
分析内容，以确定电子通信的内容的一个或多个含义
1002
查询与电子通信有关的一个或多个数据源的内容
1004
至少部分基于（i）内容的一个或多个含义以及（ii）一个或多个数据源的内容，从内容中自动提取请求或承诺
1006

图10