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(71) Applicant: META PLATFORMS TECHNOLOGIES, LLC [US/US]; 1 Meta Way, Menlo Park, California 94025 (US).

(72) Inventor: BOSWORTH, Andrew Garrod; 1 Meta Way, Menlo Park, California 94025 (US).

(74) Agent: COLBY, Steven et al.; Rimon Law, Rimon PC, 1655 W Fairview Ave, Suite 102, Boise, Idaho 83702 (US).

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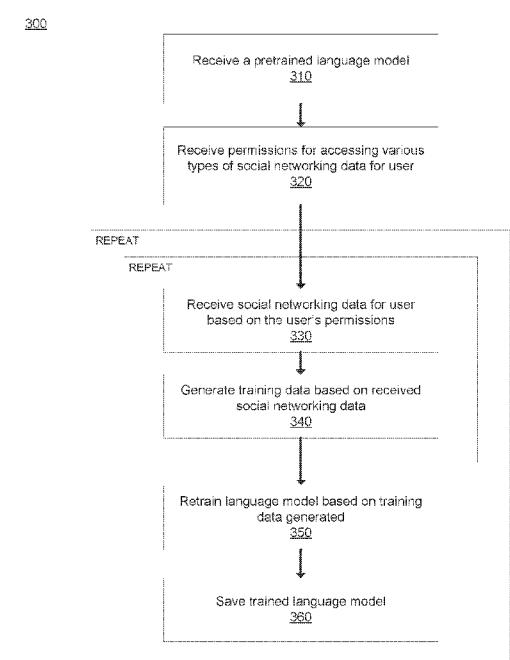
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(54) Title: SIMULATION OF A USER OF A SOCIAL NETWORKING SYSTEM USING A LANGUAGE MODEL



(57) Abstract: A social networking system simulates a user using a language model trained using training data generated from user interactions performed by that user. The language model may be used for simulating the user when the user is absent from the social networking system, for example, when the user takes a long break or if the user is deceased. The social networking system receives a language model that is pretrained and retrains the language model using user specific training data based on user interactions performed by a particular user with the social networking system. The social networking system deploys the language model retrained using the user specific training data so that a bot can invoke the language model for generating responses on behalf of the user in response to content items posted by other users.

SIMULATION OF A USER OF A SOCIAL NETWORKING SYSTEM USING A LANGUAGE MODEL

FIELD OF INVENTION

[0001] This disclosure concerns machine learning based models in general and more specifically simulation of a user of a social networking system using a machine learning based language model.

BACKGROUND

8 [0002] Social networking systems allow users to connect with other users and interact
9 with them. For examples users may post content, respond to content posted by other users,
10 for example, by commenting, liking, forwarding, or performing other interactions with the
11 content on the social networking system. Several users may be connected to a particular user
12 or follow the user to receive content generated by the user. If that user is absent from the
13 social networking platform, the users connected to the user do not receive any content from
14 the user during that user's absence. A user may be absent from the social networking
15 platform for long period of time, thereby affecting the user experience of several users on the
16 social networking system. The impact on the users is much more severe and permanent if
17 that user is deceased and can never return to the social networking platform.

SUMMARY

19 **[0003]** Embodiments simulate a user of a social networking system using a language
20 model trained using training data generated from user interactions performed by that user.
21 The language model may be used for simulating the user when the user is absent from the
22 social networking system, for example, when the user takes a long break. The language
23 model may be used for simulating a user that is deceased.

24 [0004] The social networking system receives a language model trained using training
25 data obtained from user interactions performed by a target user of the social networking
26 system. The social networking system receives a set of content items posted by other users
27 that are relevant to the target user, for example, content items provided in a newsfeed
28 generated for the target user. The social networking system identifies a content item relevant
29 to the target user from the set of content items.

30 **[0005]** The social networking system generates a response to the content item on behalf
31 of the user as follows. The social networking system generates a prompt for the language
32 model. The prompt describes the content item and requests a user interaction that the target
33 user would have performed upon viewing the content item. The social networking system
34 executes the language model using the prompt and receives a response from the language

1 model. The social networking system extracts information describing the predicted user
2 interaction from the response generated by the language model and posts an indication of the
3 user interaction on the social networking system.

4 [0006] According to an embodiment, the social networking system trains the language
5 model as follows. The social networking system receives a language model that is pretrained
6 and retrains the language model using user specific training data based on user interactions
7 performed by a target user with the social networking system. The social networking system
8 deploys the language model retrained using the user specific training data. For example, the
9 deployed language model can be subsequently invoked by a bot that performs user
10 interactions on behalf of the target user.

11 [0007] According to an embodiment, the social networking system receives permissions
12 from the target user indicating whether the target user allows or disallows a particular type of
13 user interaction for training the language model. The training data is collected in accordance
14 with the permissions. For example, the target user may indicate that comments posted on
15 content items may be used for training the language model but messages to individual
16 connections may not be used as training data.

17 [0008] According to the present invention there is provided a computer-implemented
18 method comprising: receiving a language model trained using training data obtained from
19 user interactions performed by a target user of a social networking system; receiving a set of
20 content items posted on the social networking system that are relevant to the target user,
21 wherein a content item of the set of content items is posted by another user of the social
22 networking system; identifying a content item relevant to the target user from the set of
23 content items; generating a prompt for the language model, the prompt describing the content
24 item and requesting a user interaction that the target user would have performed upon
25 viewing the content item; executing the language model using the prompt to obtain a
26 response from the language model; extracting information describing the user interaction
27 from the response generated by the language model; and posting an indication of the user
28 interaction to the social networking system.

29 [0009] Optionally the method further comprises receiving a language model that is
30 pretrained; retraining the language model using user specific training data based on user
31 interactions performed by a target user with the social networking system; and deploying the
32 language model retrained using the user specific training data.

33 [0010] Optionally the method further comprises receiving permissions from the target
34 user specifying whether the target user allows or disallows a particular user interaction for

1 use in training the language model, where the training data is collected in accordance with the
2 permissions.

3 [0011] Optionally, the set of content items are obtained from a newsfeed provided to the
4 target user by the social networking system.

5 [0012] Optionally the method further comprises receiving a language model that is
6 pretrained, and retraining the language model to obtain a plurality of language models, each
7 of the plurality of language models trained to simulate the target user at a particular age of the
8 target user, wherein the language model is one of the plurality of language models.

9 [0013] Optionally a particular language model corresponding to a particular age of the
10 target user is trained using training data collected by the social networking system up to a
11 point-in-time when the target user reached the particular age.

12 [0014] Optionally, the prompt further includes a context of the content item, the context
13 comprising information describing one or more user interactions associated with the content
14 item.

15 [0015] Optionally the prompt further includes a context of the content item, the context
16 comprising information describing a social networking connection between the target user
17 and a user that posted the content item.

18 [0016] According to the present invention there is further provided a non-transitory
19 computer readable storage medium comprising instructions that when executed by one or
20 more computer processors causes the one or more computer processors to perform steps
21 comprising: receiving a language model trained using training data obtained from user
22 interactions performed by a target user of a social networking system; receiving a set of
23 content items posted on the social networking system that are relevant to the target user,
24 wherein a content item of the set of content items is posted by another user of the social
25 networking system; identifying a content item relevant to the target user from the set of
26 content items; generating a prompt for the language model, the prompt describing the content
27 item and requesting a user interaction that the target user would have performed upon
28 viewing the content item; executing the language model using the prompt to obtain a
29 response from the language model; extracting information describing the user interaction
30 from the response generated by the language model; and posting an indication of the user
31 interaction to the social networking system.

32 [0017] Optionally the instructions further cause the one or more computer processors to
33 perform steps comprising: receiving a language model that is pretrained; retraining the
34 language model using user specific training data based on user interactions performed by a

1 target user with the social networking system; and deploying the language model retrained
2 using the user specific training data.

3 **[0018]** Optionally the instructions further cause the one or more computer processors to
4 perform steps comprising: receiving permissions from the target user specifying whether the
5 target user allows or disallows a particular user interaction for use in training the language
6 model, wherein the training data is collected in accordance with the permissions.

7 **[0019]** Optionally the set of content items are obtained from a newsfeed provided to the
8 target user by the social networking system.

9 **[0020]** Optionally the instructions further cause the one or more computer processors to
10 perform steps comprising: receiving a language model that is pretrained; and retraining the
11 language model to obtain a plurality of language models, each of the plurality of language
12 models trained to simulate the target user at a particular age of the target user, wherein the
13 language model is one of the plurality of language models.

14 **[0021]** Optionally, a particular language model corresponding to a particular age of the
15 target user is trained using training data collected by the social networking system up to a
16 point-in-time when the target user reached the particular age.

17 **[0022]** Optionally the prompt further includes a context of the content item, the context
18 comprising information describing one or more user interactions associated with the content
19 item.

20 **[0023]** Optionally the prompt further includes a context of the content item, the context
21 comprising information describing a social networking connection between the target user
22 and a user that posted the content item.

23 **[0024]** According to the present invention there is yet further provided a computer system
24 comprising: one or more computer processors; and a non-transitory computer readable
25 storage medium comprising instructions that when executed by the one or more computer
26 processors causes the one or more computer processors to perform steps comprising:
27 receiving a language model trained using training data obtained from user interactions
28 performed by a target user of a social networking system; receiving a set of content items
29 posted on the social networking system that are relevant to the target user, wherein a content
30 item of the set of content items is posted by another user of the social networking system;
31 identifying a content item relevant to the target user from the set of content items; generating
32 a prompt for the language model, the prompt describing the content item and requesting a
33 user interaction that the target user would have performed upon viewing the content item;
34 executing the language model using the prompt to obtain a response from the language

1 model; extracting information describing the user interaction from the response generated by
2 the language model; and posting an indication of the user interaction to the social networking
3 system.

4 [0025] Optionally the instructions further cause the one or more computer processors to
5 perform steps comprising: receiving a language model that is pretrained; retraining the
6 language model using user specific training data based on user interactions performed by a
7 target user with the social networking system; and deploying the language model retrained
8 using the user specific training data.

9 [0026] Optionally the instructions further cause the one or more computer processors to
10 perform steps comprising: receiving permissions from the target user specifying whether the
11 target user allows or disallows a particular user interaction for use in training the language
12 model, wherein the training data is collected in accordance with the permissions.

13 [0027] Optionally the instructions further cause the one or more computer processors to
14 perform steps comprising: receiving a language model that is pretrained; and retraining the
15 language model to obtain a plurality of language models, each of the plurality of language
16 models trained to simulate the target user at a particular age of the target user, wherein the
17 language model is one of the plurality of language models.

18 **BRIEF DESCRIPTION OF THE DRAWINGS**

19 [0010] FIG. 1 is a block diagram of a system environment for a social networking system
20 130, in accordance with one or more embodiments.

21 [0011] FIG. 2 is a block diagram of a system architecture of the social networking system
22 130, in accordance with one or more embodiments.

23 [0012] FIG. 3 illustrates a process for training a language model for simulating a social
24 networking user, in accordance with an embodiment.

25 [0013] FIG. 4 illustrates the process for simulating a social networking user based on the
26 language model, in accordance with an embodiment.

27 [0014] The figures depict various embodiments for purposes of illustration only. One
28 skilled in the art will readily recognize from the following discussion that alternative
29 embodiments of the structures and methods illustrated herein may be employed without
30 departing from the principles described herein.

31 **DETAILED DESCRIPTION**

32 *System Architecture*

33 [0013] FIG. 1 is a block diagram of a system environment 100 for a social networking
34 system 130, in accordance with one or more embodiments. The system environment 100

1 shown by FIG. 1 comprises one or more client devices 110, a third-party system 120, social
2 networking system 130, and a network 140. The social networking system 130 provides a
3 framework for simulating a user of the social networking system 130. In alternative
4 configurations, different and/or additional components may be included in the system
5 environment 100. For example, the social networking system 130 is a social networking
6 system, a content sharing network, or another system providing content to users.

7 **[0014]** The social networking system 130 comprises one or more computer systems that
8 include software and hardware for performing a group of coordinated functions or tasks. The
9 social networking system 130 is configured to receive requests from one or more client
10 devices 110 and execute computer programs associated with the received requests. As an
11 example, the social networking system 130 stores content associated with one or more users
12 and information describing user interactions with other users via the social networking
13 system. For example, a user may access content posted by other users as well as post content
14 including text, images, videos, and so on. Software executing on the social networking
15 system 130 can include a complex collection of computer programs, libraries, and related
16 data that are written in a collaborative manner, in which multiple parties or teams are
17 responsible for managing different components of the software.

18 **[0015]** According to an embodiment, the social networking system 130 includes a bot
19 150 that interacts with a language model 160. The bot 150 is configured to monitor content
20 relevant to a target user and perform interactions with the social networking system 130 on
21 behalf of the target user. For example, the bot 150 may monitor newsfeed generated by the
22 social networking system 130 for the target user. For a particular newsfeed item, the bot 150
23 determines a response that the target user would provide and sends the response via the social
24 networking system 130 on behalf of the target user.

25 **[0016]** The bot 150 executes the language model 160 to analyze content relevant to the
26 target user posted by other users of the social networking system 130 and to generate
27 corresponding responses on behalf of the target user. The bot 150 may be used to simulate
28 the target user of the social networking system 130 when the target user is absent from the
29 social networking system 130. For example, if the target user is travelling and user does not
30 have access to the social networking system 130, the bot 150 can continue to interact with the
31 social networking system 130.

32 **[0017]** The language model 160 is trained based on past user interactions by the target
33 user and therefore generates responses and content that the target user would have provided
34 in a given context if the target user was available to respond. As a result, the other users may

1 not notice an absence of the target user even though the responses are generated by the bot
2 150. It is possible that a target user is deceased and the bot 150 is used to continue simulating
3 the target user. As a result, other users can continue to experience the presence of the target
4 user in spite of the fact that the target user is deceased.

5 **[0018]** While only three client devices 110a, 110b, and 110c are illustrated in conjunction
6 with FIG. 1, there may be multiple instances of each of these entities. A user may use a client
7 device 110 to interact with the social networking system 130, for example, by posting content
8 to the social networking system or by viewing content posted by other users on the social
9 networking system. The client devices 110 are one or more computing devices capable of
10 receiving user input as well as transmitting and/or receiving data via the network 140. In one
11 embodiment, a client device 110 is a conventional computer system, such as a desktop or a
12 laptop computer. Alternatively, a client device 110 may be a device having computer
13 functionality, such as a personal digital assistant (PDA), a mobile telephone, a smartphone, or
14 another suitable device. A client device 110 is configured to communicate via the network
15 140. In one embodiment, a client device 110 executes an application allowing a user of the
16 client device 110 to interact with the social networking system 130. For example, a client
17 device 110 executes a browser application to enable interaction between the client device 110
18 and the social networking system 130 via the network 140. In another embodiment, a client
19 device 110 interacts with the social networking system 130 through an application
20 programming interface (API) running on a native operating system of the client device 110,
21 such as IOS® or ANDROID™.

22 **[0019]** One or more third-party systems 120 may be coupled to the network 140 for
23 communicating with the social networking system 130. In one embodiment, a third-party
24 system 120 allows a user to communicate with other users using channels outside of the
25 social networking system 130. For example, a third-party system 120 may allow users of the
26 social networking system 130 to interact with other users via email, messages, voice
27 messages, and so on. A third-party system 120 may have an agreement with the social
28 networking system 130 and with a user's consent, provide information describing user
29 communications or other interactions based on the third-party system 120 to the social
30 networking system 130. This information may be used as training data for training of the
31 language model 160.

32 **[0020]** The client devices 110 and the third-party system 120 are configured to
33 communicate with the social networking system 130 via the network 140. The network 140
34 may comprise any combination of local area and/or wide area networks, using both wired

1 and/or wireless communication systems. In one embodiment, the network 140 uses standard
2 communications technologies and/or protocols. For example, the network 140 includes
3 communication links using technologies such as Ethernet, 802.11, worldwide interoperability
4 for microwave access (WiMAX), 3G, 4G, code division multiple access (CDMA), digital
5 subscriber line (DSL), etc. Examples of networking protocols used for communicating via
6 the network 140 include multiprotocol label switching (MPLS), transmission control
7 protocol/Internet protocol (TCP/IP), hypertext transport protocol (HTTP), simple mail
8 transfer protocol (SMTP), and file transfer protocol (FTP). Data exchanged over the network
9 140 may be represented using any suitable format, such as hypertext markup language
10 (HTML) or extensible markup language (XML). In some embodiments, all or some of the
11 communication links of the network 140 may be encrypted using any suitable technique or
12 techniques.

13 [0021] FIG. 2 is a block diagram 200 of a system architecture of the social networking
14 system 130, in accordance with one or more embodiments. The social networking system
15 130 shown in FIG. 2 includes an action logger 205, a training data generation module 210, an
16 edge store 225, a user profile store 215, an action log 220, a machine learning module 235,
17 and the bot 150. In still other embodiments, the social networking system 130 may include
18 additional, fewer, or different components for various applications. Conventional
19 components such as network interfaces, security functions, load balancers, failover servers,
20 management and network operations consoles, and the like are not shown so as to not obscure
21 the details of the system architecture.

22 [0022] Each user of the social networking system 130 is associated with a user profile.
23 Content associated with the user profile is stored in the user profile store 215. A user profile
24 includes declarative information about the user that was explicitly shared by the user and may
25 also include profile information inferred by the social networking system 130. In one
26 embodiment, a user profile includes multiple data fields, each describing one or more
27 attributes of the corresponding social networking system user. Examples of information
28 stored in a user profile include biographic, demographic, and other types of descriptive
29 information, such as work experience, educational history, gender, interests, hobbies or
30 preferences, location and the like. A user profile may also store other information provided
31 by the user, for example, images or videos. In certain embodiments, images of users may be
32 tagged with information identifying the social networking system users displayed in an
33 image, with information identifying the images in which a user is tagged stored in the user
34 profile of the user.

1 [0023] The action logger 205 receives communications about user actions internal to
2 and/or external to the social networking system 130, populating the action log 220 with
3 information about user actions. The action log 220 may be used by the social networking
4 system 130 to track user actions on the social networking system 130, as well as actions on
5 third-party systems 120 that communicate information to the social networking system 130.
6 Users may interact with various objects on the social networking system 130, and information
7 describing these interactions is stored in the action log 220. Examples of interactions include,
8 commenting on posts, accessing a content item, liking a content item, sharing a content item,
9 commenting on a page, sharing links, checking-in to physical locations via a client device
10 110, and any other interaction. Additional examples of interactions with objects on the social
11 networking system 130 that are included in the action log 220 include: commenting on a
12 photo album, communicating with a user, establishing a connection with an object, joining an
13 event, joining a group, creating an event, authorizing an application, using an application,
14 expressing a preference for an object (“liking” the object), and engaging in a transaction.

15 [0024] The action log 220 may also store user actions taken on a third-party system 120,
16 such as an external website, and communicated to the social networking system 130. For
17 example, an e-commerce website may recognize a user of the social networking system 130
18 through a social plug-in enabling the e-commerce website to identify the user of the social
19 networking system 130. Because users of the social networking system 130 are uniquely
20 identifiable, e-commerce websites, such as in the preceding example, may communicate
21 information about a user’s actions outside of the social networking system 130 to the social
22 networking system 130 for association with the user. Hence, the action log 220 may record
23 information about actions users perform on a third-party system 120, including webpage
24 viewing histories, advertisements that were engaged, purchases made, and other patterns from
25 shopping and buying. Additionally, actions a user performs via an application associated
26 with a third-party system 120 and executing on a client device 110 may be communicated to
27 the action logger 205 by the application for recordation and association with the user in the
28 action log 220.

29 [0025] In one embodiment, the edge store 225 stores information describing connections
30 between users and other objects on the social networking system 130 as edges. Some edges
31 may be defined by users, allowing users to specify their relationships with other users. For
32 example, users may generate edges with other users that parallel the users’ real-life
33 relationships, such as friends, co-workers, partners, and so forth. Other edges are generated
34 when users interact with objects in the social networking system 130, such as expressing

1 interest in a page on the social networking system 130, sharing a link with other users of the
2 social networking system 130, and commenting on posts made by other users of the social
3 networking system 130. Edges may connect two users who are connections in a social
4 network, or may connect a user with an object in the system. In one embodiment, the nodes
5 and edges form a complex social network of connections indicating how users are related or
6 connected to each other (e.g., one user accepted a friend request from another user to become
7 connections in the social network) and how a user is connected to an object due to the user
8 interacting with the object in some manner (e.g., “liking” a page object, joining an event
9 object or a group object, etc.). Objects can also be connected to each other based on the
10 objects being related or having some interaction between them.

11 [0026] The edge store 225 also stores information about edges, such as affinity scores for
12 objects, interests, and other users. Affinity scores, or “affinities,” may be computed by the
13 social networking system 130 over time to approximate a user’s interest in an object or in
14 another user in the social networking system 130 based on the actions performed by the user.
15 A user’s affinity may be computed by the social networking system 130 over time to
16 approximate the user’s interest in an object, in a topic, or in another user in the social
17 networking system 130 based on actions performed by the user. Multiple interactions
18 between a user and a specific object may be stored as a single edge in the edge store 225, in
19 one embodiment. Alternatively, each interaction between a user and a specific object is
20 stored as a separate edge. In some embodiments, connections between users may be stored in
21 the user profile store 215, or the user profile store 215 may access the edge store 225 to
22 determine connections between users.

23 [0027] The machine learning module 235 trains the language model 160. The machine
24 learning module 235 includes a training data store 250, a training module 240, the language
25 model 160, and a model store 255. According to an embodiment, the machine learning
26 module 235 receives a pretrained language model. The pretrained language model was
27 previously trained using generic data that is not user specific. The training module 240 trains
28 the language model 160 using training data that is specific to a target user. The training of
29 the pretrained language model based on user specific training data generates a user specific
30 language model that is trained to simulate the target user.

31 [0028] According to various embodiments, the training module 240 trains the language
32 model 160 by adjusting the parameters of the language model 160 to minimize a loss function
33 for the training data specific to the target user. The training module 240 may use a technique
34 such as gradient descent to adjust the parameters. The parameters of the trained language

1 model 160 are stored in the model store 255. According to an embodiment, the machine
2 learning module performs reinforcement learning with human feedback (RLHF) to train the
3 model with feedback from the target user.

4 [0029] The training data store 250 stores user specific training data. For example, the
5 training data store 250 stores training data generated from user interactions with the social
6 networking system 130 performed by a particular user. These user interactions performed by
7 a specific user include commenting on posts, liking content items, sharing content items,
8 posting content items, sending messages to other users, going to an event, broadcasting
9 messages on a wall, and so on. The training data store 250 may store training data for
10 multiple users. The training data for a specific user is associated with a user identifier of the
11 target user. Accordingly, the training data for a particular user can be obtained by filtering
12 the data based on that user's identifier.

13 [0030] The training data generation module 210 generates training data for training the
14 language model 160. According to an embodiment, the training data generation module 210
15 obtains permissions from the target user indicating the type of social networking data that can
16 be used for training the language model 160 for the target user. For example, the social
17 networking system 130 may present a user interface to the target user displaying various
18 types of user interactions, such as, commenting on posts, sending messages to users, liking
19 comments, sharing comments, and so on. The target user can use the user interface to select
20 the types of user interactions that the target user allows the social networking system to use as
21 training data for training the language model 160 and the types of user interactions that the
22 target user disallows from being used as training data. A user may decide not to allow use of
23 messages to individual users but may allow using broadcast messages on the wall for training
24 the language model. The target user may identify a set of users and disallow user interactions
25 with those users to be used for training the language model 160. For example, the target user
26 may disallow messages sent to connections marked as family members from being used as
27 training data but allow messages sent to connections marked as friends to be used as training
28 data for training the language model. The training data generation module 210 monitors user
29 interactions that are allowed by the target user based on the user permissions and collects
30 them and stores them in the training data store 250. The user interactions of the types
31 disallowed by the target user are not included in the training data.

32 [0031] Once the language model 160 is trained, the language model 160 can be deployed
33 so that the bot 150 is able to invoke the language model 160 for a specific user. The bot 150
34 includes a content monitoring module 260 and a response generation module 265. The

1 content monitoring module 260 monitors the content of the social networking system 130 that
2 is likely to be of interest to the target user, for example, content items selected for
3 presentation to the target user via a newsfeed. The content monitoring module 260 ranks the
4 content items relevant to the target user and selects at least a subset of the content items for
5 generating a response on behalf of the target user.

6 [0032] The response generation module 265 receives a content item relevant to the target
7 user and processes the information describing the content item to generate a feature vector.
8 The response generation module 265 generates a prompt for the language model 160 based
9 on the information describing the content item as well as any contextual information relevant
10 to the content item. The response generation module 265 provides the prompt to the
11 language model 160 specific to the target user to generate a response that the target user is
12 likely to have generated if the target user viewed the same content item.

13 [0033] The response generation module 265 generates a response based on the output of
14 the language model 160 and posts the response on the social networking system. For
15 example, if the content item relevant to the target user is an image, the response generation
16 module 265 may determine based on the language model 160 that the target user would have
17 liked the image. Accordingly, the response generation module 265 invokes an API of the
18 social networking system to like the content item on behalf of the target user, thereby
19 indicating on the social networking system that the target user liked the content item.
20 Alternatively, the response generation module 265 may determine based on the language
21 model 160 that the target user would comment on the image. The response generation
22 module 265 further determines based on the language model 160 that comment that the target
23 user would have posted on the image. The response generation module 265 invokes an API of
24 the social networking system to post the comment on the content item on behalf of the target
25 user, thereby indicating on the social networking system that the target user commented on
26 the content item.

27 [0034] According to an embodiment, the machine learning module 235 trains multiple
28 language models for the same target user. Each language model corresponds to a different
29 age for the target user. For example, a language model L1 is trained to simulate the target
30 user's behavior when the target user was 20 years old, a language model L2 is trained to
31 simulate the target user's behavior when the target user was 25 years old, a language model
32 L3 is trained to simulate the target user's behavior when the target user was 30 years old, and
33 so on. The language model L corresponding to an age N is trained using the user interactions
34 performed by the target user with the social networking system until the point-in-time when

1 the target user reached that particular age N. The social networking system may be
2 configured to simulate the target user's behavior when the target user was of one of the above
3 age values.

4 *Training Process*

5 **[0054]** FIG. 3 illustrates a process for training a language model for simulating a social
6 networking user, in accordance with an embodiment. Other embodiments may include more
7 or fewer steps than indicated in FIG. 3. The steps may be executed in an order different from
8 that indicated in FIG. 3. The steps may be performed by module of the social networking
9 system, for example, the machine learning module 235.

10 **[0055]** The machine learning module 235 receives 310 a pre-trained language model.
11 The pre-trained model is trained using data that is not specific to any user and trains the
12 model to perform predictions in a user independent manner. The language model is trained to
13 receive a text as input and predict a next word for the text. The language model is repeatedly
14 invoked to make predictions representing answers for prompts.

15 **[0056]** The machine learning module 235 receives permissions for accessing various
16 types of social networking data for the target user. The permissions provided by the target
17 user may be stored in the user profile store 215. The training data generation module 210
18 receives social networking data for a user based on the target user's permissions.

19 Accordingly, the training data generation module 210 obtains social networking data
20 representing user interactions with the social networking system performed by the target user,
21 assuming the target user has granted permissions to the social networking system 130 to
22 collect that type of social networking data for training the language model 160. The training
23 data generation module 210 generates 340 training data based on the received social
24 networking data. The training data generated is stored in the training data store 250. The
25 steps 330 and 340 are repeatedly executed as the target user performs interactions with the
26 social networking system, for example, user interactions with various types of content items
27 determined to be relevant to the target user.

28 **[0057]** The training module 240 retrains 350 the language model based on the training
29 data specific to the target user generated by the training data generation module 210. The
30 retraining process adjusts the parameters of the language model to minimize a loss between
31 predicted outputs and known outputs of the training data. The parameters may be adjusted
32 based on a process such as gradient descent. The training module 240 saves 360 the
33 parameters of the trained language model in the model store 255. The steps 350 and 360 may
34 be repeated periodically, for example, based on a regular schedule or after more than a

1 threshold amount of new training data is generated compared to a previous execution of the
2 steps 350 and 360.

3 *User Simulation Process*

4 [0058] FIG. 4 illustrates the process for simulating a social networking user based on the
5 language model, in accordance with an embodiment. Other embodiments may include more
6 or fewer steps than indicated in FIG. 4. The steps may be executed in an order different from
7 that indicated in FIG. 4. The process may be executed by modules of the social networking
8 system, for example, the bot 150.

9 [0059] The trained language model is deployed 410 for use by the bot 150. The language
10 model 160 is trained to simulate a target user. The language model 160 may be made
11 available as a service via APIs (application programming interfaces) available for being
12 invoked by the bot. The bot 150 repeats the steps 420, 430, 440, 450 multiple times. The
13 content monitoring module 260 of the bot 150 receives 420 content generated by other users
14 that the social networking system 130 determines to be relevant to the target user. For
15 example, the content may be an image, a video, or text content such as comments posted by
16 users, or a story posted by a user that the social networking system 130 determines to be
17 relevant to the target user. The content may be provided as newsfeed for the target user.

18 [0060] The response generation module 265 of the bot 150 provides information
19 describing the received content item and relevant contextual information to the language
20 model 160. For example, the response generation module 265 may generate a prompt for the
21 language model 160 requesting the language model determine how the target user would
22 respond if the target user viewed the content item in the particular context.

23 [0061] The context for the content item may include one or more previous content items
24 relevant to the content item. For example, if the content item is a comment posted by a user,
25 the context may describe a previously posted content item, for example, an image for which
26 the comment was posted by the target user.

27 [0062] The contextual information may include information describing a connection
28 between a user that provided the content item and the target user. For example, if the other
29 user that provided the content item is marked as a particular type of family relation, the type
30 of family relation is specified in the prompt. Accordingly, if the same content item was
31 posted by a user U2 instead of a user U1, the language model would generate a different
32 response depending on the type of relation between each of the users U1 and U2 and the
33 target user. For example, if user U1 is a family member and user U2 is a friend, the language
34 model would generate a different response for the same content item being posted. The

1 contextual information may also specify a measure affinity between the target user and the
2 user who posted the content item. Accordingly, the language model may generate a different
3 response for content posted by users having high affinity with the target user as compared to
4 users having low affinity with the target user.

5 **[0063]** The contextual information may describe the other user that posted the content
6 item, for example, user profile attributes of the user. These may include age of the user,
7 ethnicity of the user, gender of the user, relationship status of the user, and so on. The
8 language model would generate a different response depending on the user profile attributes
9 of the user that posted the content item. The contextual information provided in the prompt
10 may indicate if the content item was posted within a threshold number of days of a particular
11 event, for example, a birthday of the target user or the other user that posted the content item,
12 a particular holiday such as thanksgiving or Christmas.

13 **[0064]** The language model 160 is executed 440 to generate a response that the target
14 user would have posted for the content item. The social networking system 130 posts an
15 indication of the response to the content item. For example, the language model 160 may
16 generate a response representing a comment for a content item and the social networking
17 system posts the comment for the content item. The language model 160 may generate a
18 response indicating that the target user may like the content item and the social networking
19 system posts an indication of a like operation by the target user for the content item.

20 **[0065]** According to an embodiment, the bot 150 performs direct interactions with
21 specific users, for example, a chat or direct messaging. According to an embodiment, the
22 responses generated by the language model are converted to audio signal to perform an audio
23 call with a user. According to an embodiment, a video generation model generates a video of
24 the target user combined with audio signal generated from text generated by the language
25 model to simulate a video call with the target user.

26 **[0066]** According to an embodiment, the responses generated on behalf of the target user
27 by the bot 150 using the language model indicate that the responses were not actually
28 generated by the target user but were instead automatically generated by a simulation of the
29 user.

30 *ADDITIONAL CONSIDERATIONS*

31 **[0058]** The foregoing description of the embodiments has been presented for the purpose
32 of illustration; it is not intended to be exhaustive or to limit the patent rights to the precise
33 forms disclosed. Persons skilled in the relevant art can appreciate that many modifications
34 and variations are possible in light of the above disclosure.

1 [0059] Some portions of this description describe the embodiments in terms of algorithms
2 and symbolic representations of operations on information. These algorithmic descriptions
3 and representations are commonly used by those skilled in the data processing arts to convey
4 the substance of their work effectively to others skilled in the art. These operations, while
5 described functionally, computationally, or logically, are understood to be implemented by
6 computer programs or equivalent electrical circuits, microcode, or the like. Furthermore, it
7 has also proven convenient at times, to refer to these arrangements of operations as modules,
8 without loss of generality. The described operations and their associated modules may be
9 embodied in software, firmware, hardware, or any combinations thereof.

10 [0060] Any of the steps, operations, or processes described herein may be performed or
11 implemented with one or more hardware or software modules, alone or in combination with
12 other devices. In one embodiment, a software module is implemented with a computer
13 program product comprising a computer-readable medium containing computer program
14 code, which can be executed by a computer processor for performing any or all of the steps,
15 operations, or processes described.

16 [0061] Embodiments may also relate to an apparatus for performing the operations
17 herein. This apparatus may be specially constructed for the required purposes, and/or it may
18 comprise a general-purpose computing device selectively activated or reconfigured by a
19 computer program stored in the computer. Such a computer program may be stored in a
20 non-transitory, tangible computer readable storage medium, or any type of media suitable for
21 storing electronic instructions, which may be coupled to a computer system bus.
22 Furthermore, any computing systems referred to in the specification may include a single
23 processor or may be architectures employing multiple processor designs for increased
24 computing capability.

25 [0062] Embodiments may also relate to a product that is produced by a computing
26 process described herein. Such a product may comprise information resulting from a
27 computing process, where the information is stored on a non-transitory, tangible computer
28 readable storage medium and may include any embodiment of a computer program product
29 or other data combination described herein.

30 [0063] Finally, the language used in the specification has been principally selected for
31 readability and instructional purposes, and it may not have been selected to delineate or
32 circumscribe the patent rights. It is therefore intended that the scope of the patent rights be
33 limited not by this detailed description, but rather by any claims that issue on an application
34 based hereon. Accordingly, the disclosure of the embodiments is intended to be illustrative,

i but not limiting, of the scope of the patent rights, which is set forth in the following claims.

1 What is claimed is:

- 2 1. A computer-implemented method comprising:
 - 3 receiving a language model trained using training data obtained from user
 - 4 interactions performed by a target user of a social networking system;
 - 5 receiving a set of content items posted on the social networking system that are
 - 6 relevant to the target user, wherein a content item of the set of content
 - 7 items is posted by another user of the social networking system;
 - 8 identifying a content item relevant to the target user from the set of content items;
 - 9 generating a prompt for the language model, the prompt describing the content
 - 10 item and requesting a user interaction that the target user would have
 - 11 performed upon viewing the content item;
 - 12 executing the language model using the prompt to obtain a response from the
 - 13 language model;
 - 14 extracting information describing the user interaction from the response generated
 - 15 by the language model; and
 - 16 posting an indication of the user interaction to the social networking system.
- 17 2. The computer-implemented method of claim 1, further comprising:
 - 18 receiving a language model that is pretrained;
 - 19 retraining the language model using user specific training data based on user
 - 20 interactions performed by a target user with the social networking system;
 - 21 and
 - 22 deploying the language model retrained using the user specific training data.
- 23 3. The computer-implemented method of claim 2, further comprising:
 - 24 receiving permissions from the target user specifying whether the target user
 - 25 allows or disallows a particular user interaction for use in training the
 - 26 language model, wherein the training data is collected in accordance with
 - 27 the permissions; or optionally wherein the set of content items are obtained
 - 28 from a newsfeed provided to the target user by the social networking
 - 29 system.
- 30 4. The computer-implemented method of claim 1, further comprising:
 - 31 receiving a language model that is pretrained; and
 - 32 retraining the language model to obtain a plurality of language models, each of the
 - 33 plurality of language models trained to simulate the target user at a
 - 34 particular age of the target user, wherein the language model is one of the

plurality of language models; and further optionally wherein a particular language model corresponding to a particular age of the target user is trained using training data collected by the social networking system up to a point-in-time when the target user reached the particular age.

5. The computer-implemented method of claim 1, wherein the prompt further includes a context of the content item, the context comprising information describing one or more user interactions associated with the content item; or
wherein the prompt further includes a context of the content item, the context comprising information describing a social networking connection between the target user and a user that posted the content item.

6. A non-transitory computer readable storage medium comprising instructions that when executed by one or more computer processors causes the one or more computer processors to perform steps comprising:

receiving a language model trained using training data obtained from user interactions performed by a target user of a social networking system; receiving a set of content items posted on the social networking system that are relevant to the target user, wherein a content item of the set of content items is posted by another user of the social networking system; identifying a content item relevant to the target user from the set of content items; generating a prompt for the language model, the prompt describing the content item and requesting a user interaction that the target user would have performed upon viewing the content item; executing the language model using the prompt to obtain a response from the language model; extracting information describing the user interaction from the response generated by the language model; and posting an indication of the user interaction to the social networking system.

7. The non-transitory computer readable storage medium of claim 6, wherein the instructions further cause the one or more computer processors to perform steps comprising:
receiving a language model that is pretrained;
retraining the language model using user specific training data based on user interactions performed by a target user with the social networking system;
and

1 deploying the language model retrained using the user specific training data.

2 8. The non-transitory computer readable storage medium of claim 7, wherein the
3 instructions further cause the one or more computer processors to perform steps comprising:
4 receiving permissions from the target user specifying whether the target user
5 allows or disallows a particular user interaction for use in training the
6 language model, wherein the training data is collected in accordance with
7 the permissions;

8 or optionally wherein the set of content items are obtained from a newsfeed
9 provided to the target user by the social networking system.

10 9. The non-transitory computer readable storage medium of claim 6, wherein the
11 instructions further cause the one or more computer processors to perform steps comprising:
12 receiving a language model that is pretrained; and
13 retraining the language model to obtain a plurality of language models, each of the
14 plurality of language models trained to simulate the target user at a
15 particular age of the target user, wherein the language model is one of the
16 plurality of language models.

17 10. The non-transitory computer readable storage medium of claim 9, wherein a
18 particular language model corresponding to a particular age of the target user is trained using
19 training data collected by the social networking system up to a point-in-time when the target
20 user reached the particular age.

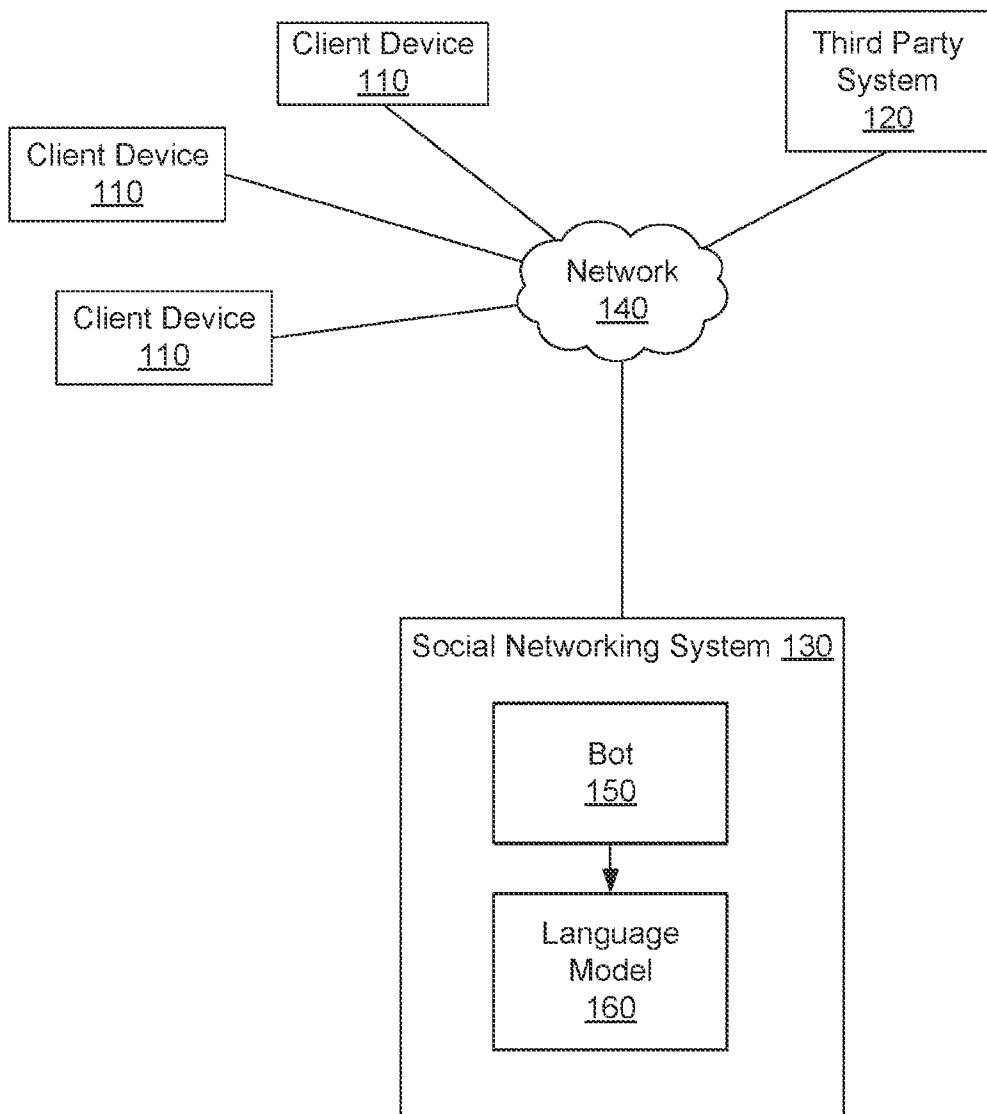
21 11. The non-transitory computer readable storage medium of claim 6, wherein the
22 prompt further includes a context of the content item, the context comprising information
23 describing one or more user interactions associated with the content item; or
24 wherein the prompt further includes a context of the content item, the context
25 comprising information describing a social networking connection between the target user
26 and a user that posted the content item.

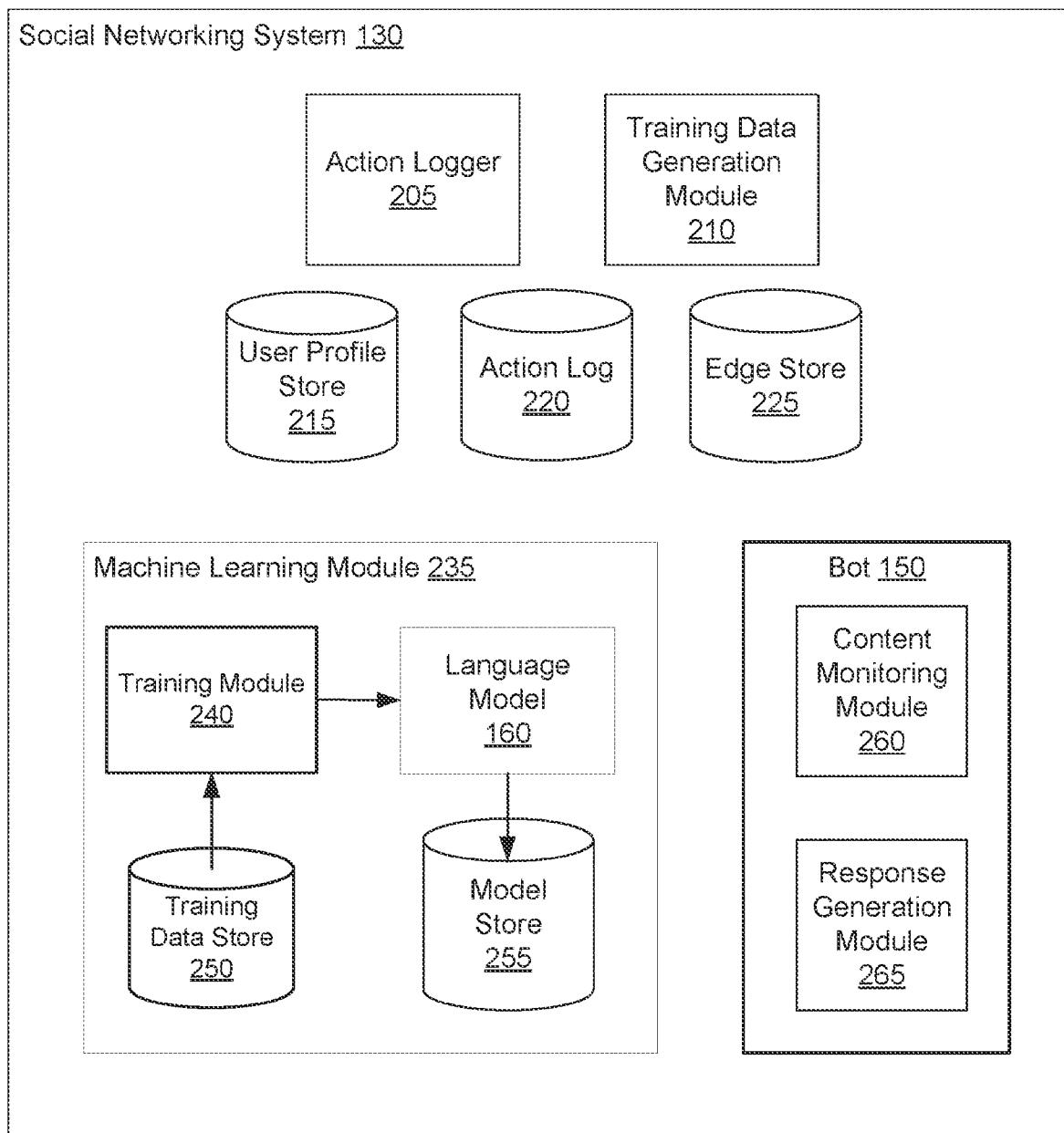
27 12. A computer system comprising:
28 one or more computer processors; and
29 a non-transitory computer readable storage medium comprising instructions that when
30 executed by the one or more computer processors causes the one or more
31 computer processors to perform steps comprising:
32 receiving a language model trained using training data obtained from user
33 interactions performed by a target user of a social networking system;
34 receiving a set of content items posted on the social networking system that

1 are relevant to the target user, wherein a content item of the set of
2 content items is posted by another user of the social networking
3 system;
4 identifying a content item relevant to the target user from the set of content
5 items;
6 generating a prompt for the language model, the prompt describing the content
7 item and requesting a user interaction that the target user would have
8 performed upon viewing the content item;
9 executing the language model using the prompt to obtain a response from the
10 language model;
11 extracting information describing the user interaction from the response
12 generated by the language model; and
13 posting an indication of the user interaction to the social networking system.
14 13. The computer system of claim 12, wherein the instructions further cause the
15 one or more computer processors to perform steps comprising:
16 receiving a language model that is pretrained;
17 retraining the language model using user specific training data based on user
18 interactions performed by a target user with the social networking system;
19 and
20 deploying the language model retrained using the user specific training data.

21 14. The computer system of claim 13, wherein the instructions further cause the
22 one or more computer processors to perform steps comprising:
23 receiving permissions from the target user specifying whether the target user
24 allows or disallows a particular user interaction for use in training the
25 language model, wherein the training data is collected in accordance with
26 the permissions.

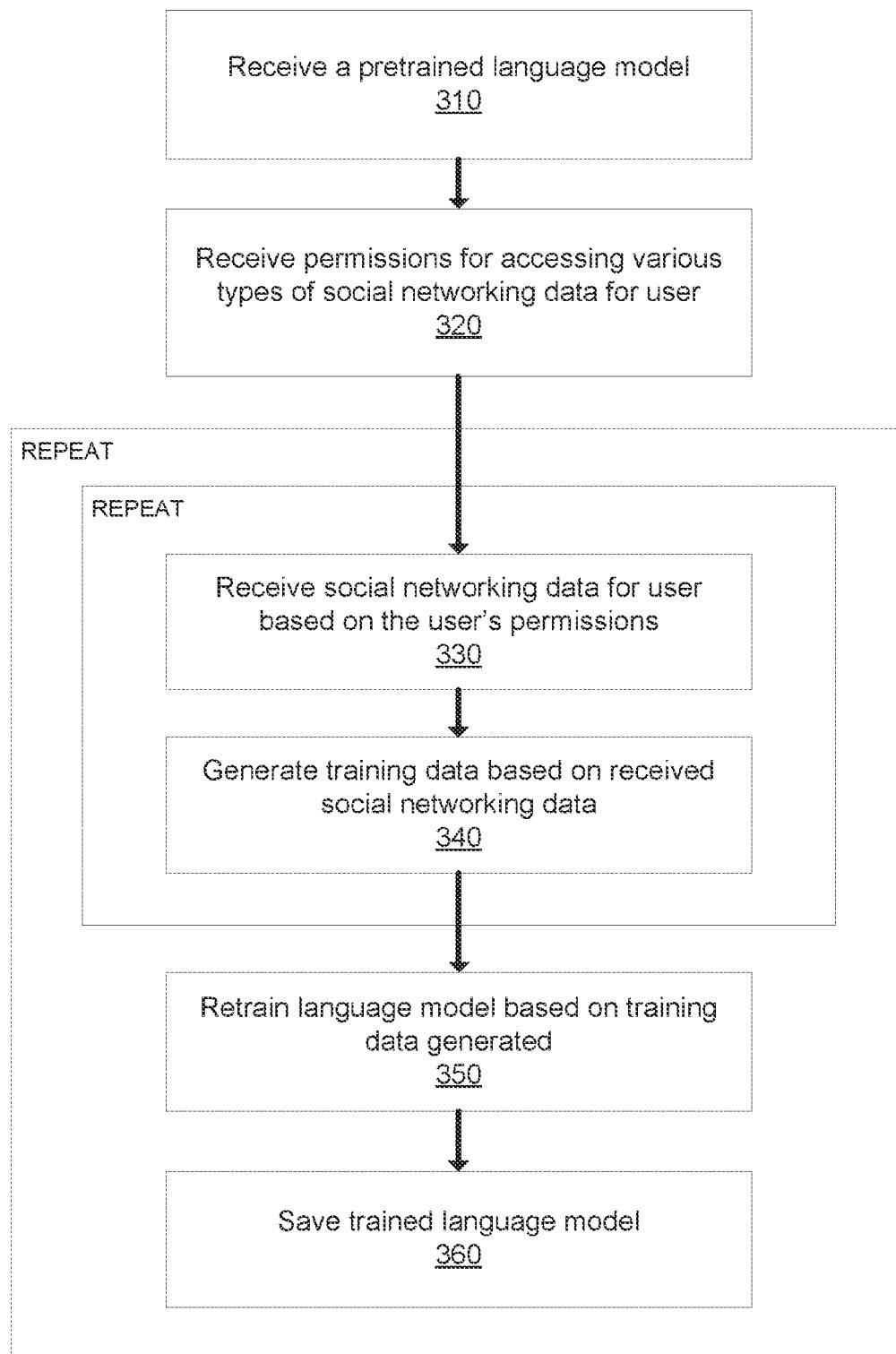
27 15. The computer system of claim 12, wherein the instructions further cause the
28 one or more computer processors to perform steps comprising:
29 receiving a language model that is pretrained; and
30 retraining the language model to obtain a plurality of language models, each of the
31 plurality of language models trained to simulate the target user at a
32 particular age of the target user, wherein the language model is one of the
33 plurality of language models.

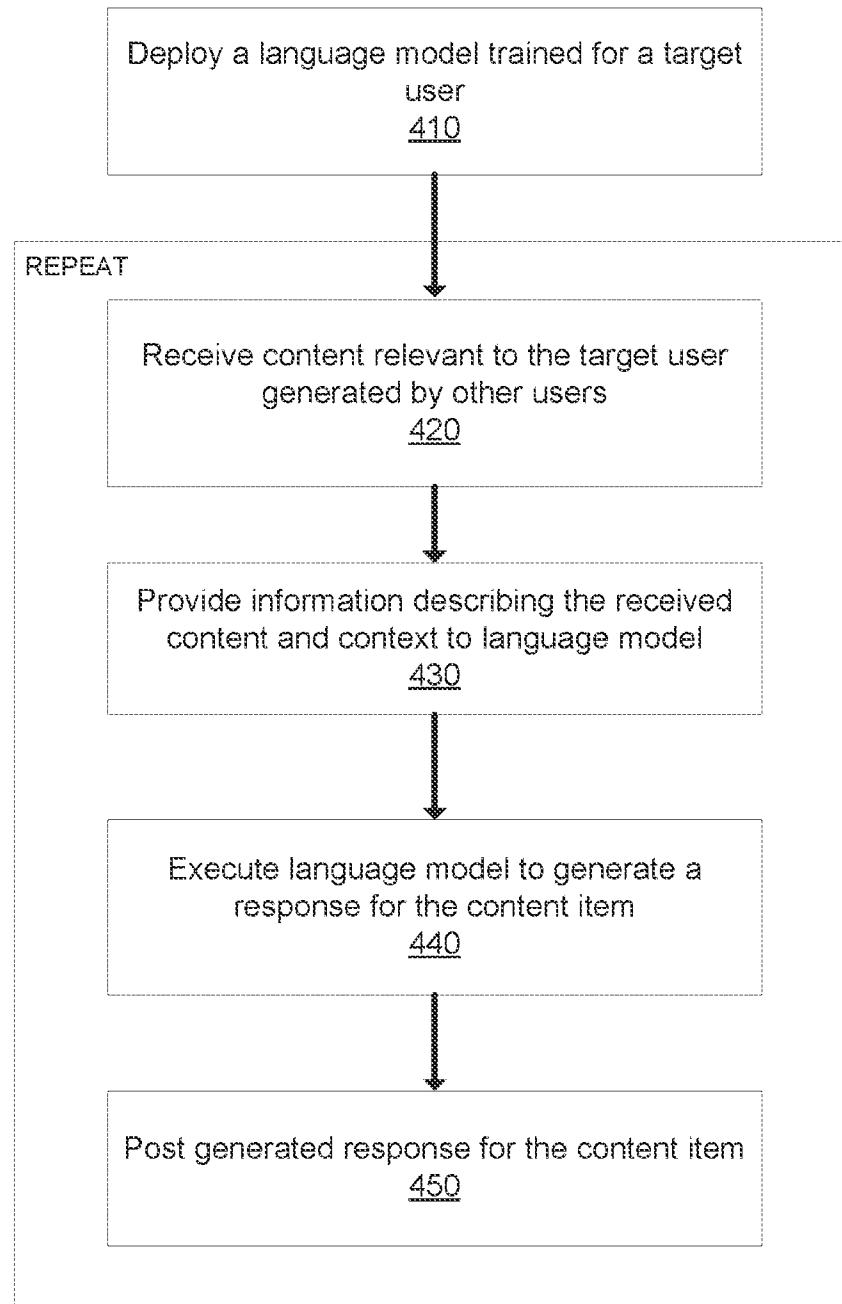
100**FIG. 1**

**FIG. 2**

3/4

300

**FIG. 3**

400**FIG. 4**

INTERNATIONAL SEARCH REPORT

International application No PCT/US2024/045744

A. CLASSIFICATION OF SUBJECT MATTER

INV. G06Q50/00 G06F40/20 G06N20/00

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 G06N G06F

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

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

EPO- Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2020/026755 A1 (HEWITT TRUDY L [US] ET AL) 23 January 2020 (2020-01-23) paragraph [0002] paragraph [0016] - paragraph [0069] ----- US 2020/126174 A1 (HALSE SHANE [US] ET AL) 23 April 2020 (2020-04-23) paragraph [0002] - paragraph [0009] paragraph [0079] - paragraph [0100] -----	1 - 15
X		1 - 15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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"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

16 October 2024

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

Authorized officer

Moynihan, Maurice

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2024/045744

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2020026755 A1	23-01-2020	US 2020026755 A1 US 2020257859 A1	23-01-2020 13-08-2020
US 2020126174 A1	23-04-2020	NONE	