United States Patent	12393613
Kind Code	B2
Date of Patent	August 19, 2025
Inventor(s)	Brewer; Jason et al.

Systems, devices, and methods for content selection

Abstract

Disclosed are systems, methods, and computer-readable storage media to present content on an electronic display. In one aspect, a method includes identifying a first candidate content and a second candidate content for presentation on an electronic display, determining a first probability and a second probability that the first candidate content and the second candidate content respectively will elicit a particular type of input response, determining a first weight and a second weight based on the first probability and the second probability respectively, selecting either the first content or the second content based on the first weight and the second weight; and presenting the selected content on the electronic display.

Inventors: Brewer; Jason (Mountain View, CA), Farnham; Rodrigo B. (Los Angeles, CA), Khajehnouri; Nima (Santa Monica, CA), Lue; David B. (Santa Monica, CA), Xu; Zhuo (Los Angeles, CA)

Applicant: Snap Inc. (Santa Monica, CA)

Family ID: 1000008763463

Assignee: Snap Inc. (Santa Monica, CA)

Appl. No.: 18/643404

Filed: April 23, 2024

Prior Publication Data

Document Identifier	Publication Date
US 20240273122 A1	Aug. 15, 2024

Related U.S. Application Data

continuation parent-doc US 17522080 20211109 US 11995108 child-doc US 18643404
continuation parent-doc US 16049318 20180730 US 11204949 child-doc US 17522080

Publication Classification

Int. Cl.: **G06F16/00** (20190101); **G06F16/31** (20190101); **G06F16/335** (20190101); **G06F17/18** (20060101); **G06Q50/00** (20120101)

U.S. Cl.:

CPC **G06F16/313** (20190101); **G06F16/335** (20190101); **G06F17/18** (20130101); **G06Q50/01** (20130101);

Field of Classification Search

CPC: G06F (16/313); G06F (16/335); G06F (17/18)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
7971156	12/2010	Albertson et al.	N/A	N/A
7996793	12/2010	Latta et al.	N/A	N/A
8487938	12/2012	Latta et al.	N/A	N/A
8856691	12/2013	Geisner et al.	N/A	N/A
9225897	12/2014	Sehn et al.	N/A	N/A
9230160	12/2015	Kanter	N/A	N/A
9276886	12/2015	Samaranayake	N/A	N/A
9705831	12/2016	Spiegel	N/A	N/A
9742713	12/2016	Spiegel et al.	N/A	N/A
10102423	12/2017	Shaburov et al.	N/A	N/A
10275792	12/2018	Bell	N/A	G06Q 30/0255
10284508	12/2018	Allen et al.	N/A	N/A
10439972	12/2018	Spiegel et al.	N/A	N/A
10509466	12/2018	Miller et al.	N/A	N/A
10514876	12/2018	Sehn	N/A	N/A
10579869	12/2019	Xiong et al.	N/A	N/A
10581953	12/2019	Brewer et al.	N/A	N/A
10591730	12/2019	Rodriguez, II et al.	N/A	N/A
10614855	12/2019	Huang	N/A	N/A
10748347	12/2019	Li et al.	N/A	N/A
10872123	12/2019	Arora	N/A	G06F 16/9535
10958608	12/2020	Allen et al.	N/A	N/A
10962809	12/2020	Castañeda	N/A	N/A
10996846	12/2020	Robertson et al.	N/A	N/A
10997787	12/2020	Ge et al.	N/A	N/A
11012390	12/2020	Al Majid et al.	N/A	N/A
11030454	12/2020	Xiong et al.	N/A	N/A

11036368	12/2020	Al Majid et al.	N/A	N/A
11062498	12/2020	Voss et al.	N/A	N/A
11087728	12/2020	Canberk et al.	N/A	N/A
11092998	12/2020	Castañeda et al.	N/A	N/A
11106342	12/2020	Al Majid et al.	N/A	N/A
11113730	12/2020	Birkett	N/A	G06N 5/04
11126206	12/2020	Meisenholder et al.	N/A	N/A
11143867	12/2020	Rodriguez, II	N/A	N/A
11169600	12/2020	Canberk et al.	N/A	N/A
11204949	12/2020	Brewer et al.	N/A	N/A
11227626	12/2021	Krishnan Gorumkonda et al.	N/A	N/A
11307747	12/2021	Dancie et al.	N/A	N/A
11531402	12/2021	Stolzenberg	N/A	N/A
11546505	12/2022	Canberk	N/A	N/A
2009/0012788	12/2008	Gilbert et al.	N/A	N/A
2010/0262602	12/2009	Dumon	707/E17.108	G06Q 30/02
2011/0184806	12/2010	Chen et al.	N/A	N/A
2011/0301934	12/2010	Tardif	N/A	N/A
2011/0307411	12/2010	Bolivar	707/E17.084	G06F 16/9535
2012/0130813	12/2011	Hicken et al.	N/A	N/A
2012/0158491	12/2011	Goulden et al.	N/A	N/A
2012/0272265	12/2011	Flatt et al.	N/A	N/A
2013/0290116	12/2012	Hepworth et al.	N/A	N/A
2014/0074824	12/2013	Rad et al.	N/A	N/A
2014/0171036	12/2013	Simmons	N/A	N/A
2014/0223329	12/2013	Falaki et al.	N/A	N/A
2014/0278973	12/2013	Lowe et al.	N/A	N/A
2014/0282281	12/2013	Ram et al.	N/A	N/A
2015/0120293	12/2014	Wohlert et al.	N/A	N/A
2015/0277755	12/2014	Hoffman	N/A	N/A
2015/0370320	12/2014	Connor	N/A	N/A
2016/0027100	12/2015	Monkman	705/26.3	G06Q 30/0275
2016/0283978	12/2015	Rabbat et al.	N/A	N/A
2017/0032450	12/2016	Jia et al.	N/A	N/A
2017/0061515	12/2016	Hummel	N/A	G06F 16/9535
2017/0123487	12/2016	Hazra et al.	N/A	N/A
2017/0178181	12/2016	Liu	N/A	G06Q 30/0275
2017/0213238	12/2016	Bhalgat	N/A	G06Q 30/0275
2017/0277684	12/2016	Dharmarajan Mary	N/A	N/A
2017/0277685	12/2016	Takumi	N/A	N/A
2017/0351910	12/2016	Elwazer et al.	N/A	N/A

2018/0067641	12/2017	Lerner et al.	N/A	N/A
2018/0158370	12/2017	Pryor	N/A	N/A
2018/0204250	12/2017	Watine et al.	N/A	N/A
2019/0146219	12/2018	Rodriguez, II	N/A	N/A
2019/0244267	12/2018	Rattner et al.	N/A	N/A
2020/0013079	12/2019	Herman et al.	N/A	N/A
2020/0175543	12/2019	Wigder	N/A	N/A
2021/0011612	12/2020	Dancie et al.	N/A	N/A
2021/0074016	12/2020	Li et al.	N/A	N/A
2021/0166732	12/2020	Shaburova et al.	N/A	N/A
2021/0174034	12/2020	Retek et al.	N/A	N/A
2021/0241529	12/2020	Cowburn et al.	N/A	N/A
2021/0303075	12/2020	Cowburn et al.	N/A	N/A
2021/0303077	12/2020	Anvaripour et al.	N/A	N/A
2021/0303140	12/2020	Mourkogiannis	N/A	N/A
2021/0382564	12/2020	Blachly et al.	N/A	N/A
2021/0397000	12/2020	Rodriguez, II	N/A	N/A
2021/0405761	12/2020	Canberk	N/A	N/A
2022/0138237	12/2021	Brewer et al.	N/A	N/A
2022/0188539	12/2021	Chan et al.	N/A	N/A
2022/0206588	12/2021	Canberk et al.	N/A	N/A
2022/0300730	12/2021	Eirinberg et al.	N/A	N/A
2022/0300731	12/2021	Eirinberg et al.	N/A	N/A
2022/0301231	12/2021	Eirinberg et al.	N/A	N/A
2022/0326781	12/2021	Hwang et al.	N/A	N/A
2022/0334649	12/2021	Hwang et al.	N/A	N/A
2022/0375174	12/2021	Arya et al.	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
103049761	12/2015	CN	N/A
3707693	12/2019	EP	N/A
4172726	12/2022	EP	N/A
4172730	12/2022	EP	N/A
20220158824	12/2021	KR	N/A
WO-2016168591	12/2015	WO	N/A
WO-2019094618	12/2018	WO	N/A
WO-2022005687	12/2021	WO	N/A
WO-2022005693	12/2021	WO	N/A
WO-2022060549	12/2021	WO	N/A
WO-2022066578	12/2021	WO	N/A
WO-2022060549	12/2021	WO	N/A
WO-2022132381	12/2021	WO	N/A
WO-2022146678	12/2021	WO	N/A
WO-2022198182	12/2021	WO	N/A
WO-2022216784	12/2021	WO	N/A
WO-2022225761	12/2021	WO	N/A
WO-2022245765	12/2021	WO	N/A

OTHER PUBLICATIONS

"U.S. Appl. No. 16/049,318, Advisory Action mailed Jun. 28, 2021", 11 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Advisory Action mailed Oct. 19, 2020", 3 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Examiner Interview Summary mailed Jun. 30, 2020", 4 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Final Office Action mailed May 3, 2021", 20 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Final Office Action mailed Aug. 5, 2020", 16 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Non Final Office Action mailed Apr. 27, 2020", 14 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Non Final Office Action mailed Dec. 14, 2020", 20 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Notice of Allowance mailed Aug. 9, 2021", 8 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Response filed Mar. 9, 2021 to Non Final Office Action mailed Dec. 14, 2020", 10 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Response filed Jun. 22, 2021 to Final Office Action mailed May 3, 2021", 10 pages. cited by applicant
"U.S. Appl. No. 16/049,318, Response filed Jun. 30, 2020 to Non Final Office Action mailed Apr. 27, 2020", 11 pgs. cited by applicant
"U.S. Appl. No. 16/049,318, Response filed Jul. 28, 2021 to Advisory Action mailed Jun. 29, 2021", 14 pages. cited by applicant
"U.S. Appl. No. 16/049,318, Response filed Oct. 5, 2020 to Final Office Action mailed Aug. 5, 2020", 10 pgs. cited by applicant
"U.S. Appl. No. 17/522,080, Non Final Office Action mailed Aug. 3, 2023", 28 pgs. cited by applicant
"U.S. Appl. No. 17/522,080, Notice of Allowance mailed Jan. 24, 2024", 8 pgs. cited by applicant
"U.S. Appl. No. 17/522,080, Response filed Oct. 31, 2023 to Non Final Office Action mailed Aug. 3, 2023", 10 pgs. cited by applicant
"U.S. Appl. No. 17/522,080, Supplemental Notice of Allowability mailed Jan. 31, 2024", 2 pgs. cited by applicant

---

Primary Examiner: Khong; Alexander

Attorney, Agent or Firm: Schwegman Lundberg & Woessner, P.A.

Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of U.S. patent application Ser. No. 17/522,080, filed on Nov. 9, 2021, which is a continuation of U.S. patent application Ser. No. 16/049,318, filed on Jul. 30, 2018, now issued as U.S. Pat. No. 11,204,949, which claims priority to U.S. Provisional Application Ser. No. 62/539,392, filed on Jul. 31, 2017. The disclosures of the prior applications are considered part of this application, and are hereby incorporated by reference in their entireties.

TECHNICAL FIELD
(1) The present disclosure generally relates to the technical field of managing the display of content to users of a social network. Specifically, disclosed are methods for presenting content based on how a user may respond to the content.
BACKGROUND
(2) Social networking is becoming essential to many as a form of communication. Social

networking applications enable a user to view content provided by other users. Users may also be able to view other content, for example, content providing information such as news, historical information, or other types of information. Some information provided to a social network user may be more relevant and/or interesting to that user. Thus, the user may respond differently to the information, depending on to what extent the user has interest in the information. Therefore, methods and systems to provide the most valuable information to a user of a social network are desirable.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) In the drawings, which are not necessarily drawn to scale, like numerals may describe similar components in different views. Like numerals having different letter suffixes may represent different instances of similar components. Some embodiments are illustrated by way of example, and not limitation, in the figures of the accompanying drawings.
(2) FIG. **1** is an exemplary block diagram of a messaging system for exchanging data (e.g., messages and associated content) over a network.
(3) FIG. **2** is block diagram illustrating further details regarding the messaging system, according to some embodiments.
(4) FIG. **3** is an exemplary data base schema utilized by the messaging system of FIG. **1**.
(5) FIG. **4** is an exemplary block diagram illustrating functional components of a content selection system that forms part of the messaging system, according to some example embodiments.
(6) FIG. **5**A is an illustration of competitive bidding for presentation of content.
(7) FIG. **5**B is an illustration of competitive bidding for presentation of content.
(8) FIG. **5**C is a data flow diagram for an exemplary embodiment.
(9) FIGS. **6**A-B show a historical response database and a content database respectively.
(10) FIGS. **7**A-B show two exemplary database schemas.
(11) FIG. **8**A is a flowchart of a method for displaying content on an electronic display.
(12) FIG. **8**B is a graph showing weightings for model input parameters.
(13) FIG. **9** is a flowchart for a method of aggregating statistics for presentation of content.
(14) FIGS. **10**A-B show results of one implementation of a prediction model utilized by the disclosed methods and systems.
(15) FIG. **11** is an exemplary receiver operating characteristic curve. As the area under the curve increases, the precision of a model generating the curve is improving.
(16) FIG. **12** is an exemplary precision recall curve for one implementation of a model utilized in the disclosed systems and methods.
(17) FIG. **13** shows a calibration of a prediction model utilized by some of the disclosed methods and systems.
(18) FIG. **14**A-D show four graphs **1400***a-d* respectively, the graphs showing data that may be monitored and utilized by some models of the disclosed methods, devices, and systems.
(19) FIG. **15**A shows a line graph of a sum of swipe probabilities predicted by a particular time of day.
(20) FIG. **15**B shows a line graph of a number of swipes performed by a particular time of day.
(21) FIG. **16** shows bid prices for impressions to a user increasing as the user's frequency of swipes increases.
(22) FIGS. **17**A-B contrasts bid and actual prices for presentation of content.
(23) FIG. **18** is a block diagram illustrating an example software architecture
(24) FIG. **19** is a block diagram illustrating exemplary components (also referred to herein as "modules") of a machine.

(25) FIG. **20** is an exemplary data flow diagram of a process employing a predictive model to determine probabilities of different types of responses to particular content.

DETAILED DESCRIPTION

(26) The description that follows includes systems, methods, techniques, instruction sequences, and computing machine program products that embody illustrative embodiments of the disclosure. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide an understanding of various embodiments of the inventive subject matter. It will be evident, however, to those skilled in the art, that embodiments of the inventive subject matter may be practiced without these specific details. In general, well-known instruction instances, protocols, structures, and techniques are not necessarily shown in detail.

(27) Aspects of the present disclosure include systems, methods, techniques, instruction sequences, and computing machine program products that provide for the selection of content for display. The selection of content may be based on a probability of a particular type of response to the content. In some aspects, the probability of a response is based on a historical record of responses. For example, if a first type of response to particular content was historically provided a certain percentage of the time (such as a swipe down or skip operation), than an estimate for the first type of response to be provided in response to a new presentation of the particular content may be estimated at the certain percentage.

(28) The disclosed methods and systems may provide for the display of a plurality of different content. Several types of input may be provided by the user in response to the content. One type of input may be a request by the user to complete interaction with a first displayed content, and to view other content. For example, in some aspects, a "swipe down" input after the first content is displayed may indicate a user request to view other content. Another type of input may indicate a request to view second content. The first content may prompt the user to view the second content in some aspects. For example, in some aspects, a "swipe up" input may indicate a user request to view the prompted second content.

(29) The disclosed methods and systems may record how a user responds to content. For example, statistics may be maintained indicating for example, how many times a particular content is presented, how many times the user's response requested prompted content, and how many times the user's response requested other content. From this information, when content is presented, it may be possible to predict how the user will respond. For example, if a user historically requests prompted content 5% of the time, it is likely that when the content is presented, a probability that the user requests the prompted content is 5%.

(30) The disclosed methods and systems may then determine whether to present a first or a second content based in part on the probability of a desired or prompted response to each of the content. In some aspects, content with a higher probability of a requested response may be favored over content with a lower probability. However, other embodiments may select the lower probability content for a variety of reasons discussed in more detail below.

(31) Some aspects may utilize the methods, systems, and devices to provide for improved estimation of a value of a content presentation to an entity funding the presentation. For example, an advertiser on a social networking site may be charged a fee for each presentation of their content. The advertisement may provide a way for a viewer to learn more about an advertised product or service by entering a particular input, such as clicking on a link or swiping over the advertisement in a certain manner. Other responses may dismiss the advertisement and move the viewer on to other content. For example, in some aspects, an escape key or "swipe down" gesture may signal a request by the viewer to dismiss the advertisement and move on to other content. Regardless of whether a presentation results in a positive response by a viewer of the advertisement, the advertisement may be charged the same fec. Thus, the advertiser may bear the financial risk of advertising.

(32) Different advertisements may have different likelihoods of positive responses. For example, a

first advertisement by a first advertiser may elicit a positive response ten (10) percent of the time while a second advertisement by a second advertiser may elicit a positive response 70% percent of the time. If these two advertisers compete directly for advertising space on a social network, the first advertiser may be provided with more value than the second advertiser, due to the first advertiser's higher response rate. The disclosed methods and systems may enable the first and second advertisers to improve their estimates for the value provided by presentation of a particular advertisement. For example, advertisements with a higher positive response rate may in general, be more valuable that advertisements with a relatively lower positive response rate.

(33) Knowledge of an advertisement's response probability may enable the advertiser to set a bid amount for presentation of the advertisement that is better aligned with their return on investment. For example, when two advertisers compete for presentation of their respective advertisements via an electronic bidding process, an advertiser with a higher predict return on their investment may be able to bid a higher amount than an advertiser with a relatively lower return.

(34) Furthermore, different types of advertisers may place different values on advertising responses. For example, brand advertisers seek to get their message to as many people as possible. This may generate "buzz" and/or promote brand awareness. Goals of these types of advertisers may be centered around impressions and reach, and may place less emphasis on particular responses by readers of their advertisements than other advertisers, such as direct response advertisers.

(35) Direct response advertisers have a specific goal in mind. For example, the direct response advertisers seek to induce particular actions by users when those users are presented with an advertisement. Example goals include inducing the user to request additional information, for example by watching a long form video. Alternatively, these advertisers may hope to induce the user to install an application, or make an electronic purchase in response to the advertisement.

(36) In some aspects, the disclosed methods and systems shifts some risk associated with funding of presentation of content to a provider of a messaging system. In implementations that do not utilize the disclosed systems and methods, another entity, such as an advertiser, pay for presentation of particular content, and the advertiser assumes risk associated with a positive result of the presentation. In these implementations, the advertiser pays for the presentation of content, regardless of any positive result. In the methods and systems disclosed herein, some of that risk is mitigated by the provider of the messaging system. The provider of the messaging system may determine a probability of a positive result for the advertiser. By providing this information, the provider of the messaging system takes a risk that a value of presentation of particular content may be reduced when compared to systems that do not provide this probability information. In some aspects, since the provider of the messaging system is assuming at least a portion of the risk, the provider may be able to more effectively mitigate the risk when compared to the advertiser, due to the providers position and visibility to the messaging system as a whole.

(37) FIG. **1** is a block diagram showing an example messaging system **100** for exchanging data (e.g., messages and associated content) over a network. The messaging system **100** includes multiple client devices **102**, each of which hosts a number of applications including a messaging client application **104**. Each messaging client application **104** is communicatively coupled to other instances of the messaging client application **104** and a messaging server system **108** via a network **106** (e.g., the Internet). As used herein, the term "client device" may refer to any machine that interfaces with a communications network (such as the network **106**) to obtain resources from one or more server systems or other client devices. A client device may be, but is not limited to, a mobile phone, desktop computer, laptop, portable digital assistant (PDA), smart phone, tablet, ultra book, netbook, laptop, multi-processor system, microprocessor-based or programmable consumer electronics system, game console, set-top box, or any other communication device that a user may use to access a network.

(38) In the example shown in FIG. **1**, each messaging client application **104** is able to communicate and exchange data with another messaging client application **104** and with the messaging server

system **108** via the network **106**. The data exchanged between the messaging client applications **104**, and between a messaging client application **104** and the messaging server system **108**, includes functions (e.g., commands to invoke functions) as well as payload data (e.g., text, audio, video, or other multimedia data).

(39) The network **106** may include, or operate in conjunction with, an ad hoc network, an intranet, an extranet, a virtual private network (VPN), a local area network (LAN), a wireless LAN (WLAN), a wide area network (WAN), a wireless WAN (WWAN), a metropolitan area network (MAN), the Internet, a portion of the Internet, a portion of the Public Switched Telephone Network (PSTN), a plain old telephone service (POTS) network, a cellular telephone network, a wireless network, a Wi-Fi® network, another type of network, or a combination of two or more such networks. For example, the network **106** or a portion of the network **106** may include a wireless or cellular network and the connection to the network **106** may be a Code Division Multiple Access (CDMA) connection, a Global System for Mobile communications (GSM) connection, or another type of cellular or wireless coupling. In this example, the coupling may implement any of a variety of types of data transfer technology, such as Single Carrier Radio Transmission Technology (1×RTT), Evolution-Data Optimized (EVDO) technology, General Packet Radio Service (GPRS) technology, Enhanced Data rates for GSM Evolution (EDGE) technology, third-Generation Partnership Project (3GPP) including 3G, fourth-generation wireless (4G) networks, Universal Mobile Telecommunications System (UMTS), High-Speed Packet Access (HSPA), Worldwide Interoperability for Microwave Access (WiMAX), Long-Term Evolution (LTE) standard, or others defined by various standard-setting organizations, other long-range protocols, or other data transfer technology.

(40) The messaging server system **108** provides server-side functionality via the network **106** to a particular messaging client application **104**. While certain functions of the messaging system **100** are described herein as being performed by either a messaging client application **104** or by the messaging server system **108**, it will be appreciated that the location of certain functionality either within the messaging client application **104** or the messaging server system **108** is a design choice. For example, it may be technically preferable to initially deploy certain technology and functionality within the messaging server system **108**, but to later migrate this technology and functionality to the messaging client application **104** where a client device **102** has a sufficient processing capacity.

(41) The messaging server system **108** supports various services and operations that are provided to the messaging client application **104**. Such operations include transmitting data to, receiving data from, and processing data generated by the messaging client application **104**. This data may include message content, client device information, geolocation information, media annotation and overlays, message content persistence conditions, social network information, and live event information, as examples. Data exchanges within the messaging system **100** are invoked and controlled through functions available via user interfaces (UIs) of the messaging client application **104**.

(42) Turning now specifically to the messaging server system **108**, an Application Programming Interface (API) server **110** is coupled to, and provides a programmatic interface to, an application server **112**. The application server **112** is communicatively coupled to a database server **118**, which facilitates access to a database **120** in which is stored data associated with messages processed by the application server **112**.

(43) The API server **110** receives and transmits message data (e.g., commands and message payloads) between the client device **102** and the application server **112**. Specifically, the API server **110** provides a set of interfaces (e.g., routines and protocols) that can be called or queried by the messaging client application **104** in order to invoke functionality of the application server **112**. The API server **110** exposes various functions supported by the application server **112**, including account registration; login functionality; the sending of messages, via the application server **112**,

from a particular messaging client application **104** to another messaging client application **104**; the sending of media files (e.g., images or video) from a messaging client application **104** to the application server **112**, for possible access by another messaging client application **104**; the setting of a collection of media data (e.g., story); the retrieval of a list of friends of a user of a client device **102**; the retrieval of such collections; the retrieval of messages and content; the adding and deletion of friends to and from a social graph; the location of friends within a social graph; and the detecting of an application event (e.g., relating to the messaging client application **104**).

(44) The application server **112** hosts a number of applications and subsystems, including a messaging server application **114** and a social network system **116**. The messaging server application **114** implements a number of message processing technologies and functions, particularly related to the aggregation and other processing of content (e.g., textual and multimedia content) included in messages received from multiple instances of the messaging client application **104**. As will be described in further detail, the text and media content from multiple sources may be aggregated into collections of content (e.g., called stories or galleries). These collections are then made available, by the messaging server application **114**, to the messaging client application **104**. Other processor- and memory-intensive processing of data may also be performed server-side by the messaging server application **114**, in view of the hardware requirements for such processing.

(45) The social network system **116** supports various social networking functions and services, and makes these functions and services available to the messaging server application **114**. To this end, the social network system **116** maintains and accesses an entity graph within the database **120**. Examples of functions and services supported by the social network system **116** include the identification of other users of the messaging system **100** with whom a particular user has relationships or whom the user is "following," and also the identification of other entities and interests of a particular user.

(46) FIG. **2** is block diagram illustrating further details regarding the messaging system **100**, according to exemplary embodiments. Specifically, the messaging system **100** is shown to comprise the messaging client application **104** and the application server **112**, which in turn embody a number of subsystems, namely an ephemeral timer system **202**, a collection management system **204**, an annotation system **206**, and a content selection system **208**.

(47) The ephemeral timer system **202** is responsible for enforcing the temporary access to content permitted by the messaging client application **104** and the messaging server application **114**. To this end, the ephemeral timer system **202** incorporates a number of timers that, based on duration and display parameters associated with a message, or collection of messages (e.g., a SNAPCHAT story, such as the story component **404** discussed below), selectively display and enable access to messages and associated content via the messaging client application **104**. Further details regarding the operation of the ephemeral timer system **202** are provided below.

(48) The collection management system **204** is responsible for managing collections of media (e.g., collections of text, image, video, and audio data). In some examples, a collection of content (e.g., messages, including images, video, text, and audio) may be organized into an "event gallery" or an "event story." Such a collection may be made available for a specified time period, such as the duration of an event to which the content relates. For example, content relating to a music concert may be made available as a "story" for the duration of that music concert. The collection management system **204** may also be responsible for publishing an icon that provides notification of the existence of a particular collection to the user interface of the messaging client application **104**.

(49) The annotation system **206** provides various functions that enable a user to annotate or otherwise modify or edit media content associated with a message. For example, the annotation system **206** provides functions related to the generation and publishing of media overlays for messages processed by the messaging system **100**. For example, the annotation system **206** operatively supplies a media overlay (e.g., a SNAPCHAT filter) to the messaging client application

104 based on a geolocation of the client device **102**. In another example, the annotation system **206** operatively supplies a media overlay to the messaging client application **104** based on other information, such as social network information of the user of the client device **102**. A media overlay may include audio and visual content and visual effects. Examples of audio and visual content include pictures, texts, logos, animations, and sound effects. An example of a visual effect includes color overlaying. The audio and visual content or the visual effects can be applied to a media content item (e.g., a photo) at the client device **102**. For example, the media overlay may include text that can be overlaid on top of a photograph generated by the client device **102**. In another example, the media overlay includes an identification of a location (e.g., Venice Beach), a name of a live event, or a name of a merchant (e.g., Beach Coffee House). In another example, the annotation system **206** uses the geolocation of the client device **102** to identify a media overlay that includes the name of a merchant at the geolocation of the client device **102**. The media overlay may include other indicia associated with the merchant. The media overlays may be stored in the database **120** and accessed through the database server **118**.

(50) In one exemplary embodiment, the annotation system **206** provides a user-based publication platform that enables users to select a geolocation on a map, and upload content associated with the selected geolocation. The user may also specify circumstances under which a particular media overlay should be offered to other users. The annotation system **206** generates a media overlay that includes the uploaded content and associates the uploaded content with the selected geolocation.

(51) In another exemplary embodiment, the annotation system **206** provides a merchant-based publication platform that enables merchants to select a particular media overlay associated with a geolocation via a bidding process. For example, the annotation system **206** associates the media overlay of a highest-bidding merchant with a corresponding geolocation for a predefined amount of time.

(52) The content selection system **208** may provide for selective presentation of content. In some aspects, the content selection system **208** may determine probabilities of particular responses to presented content based on a number of factors. These predictions may be based on prior results when the same content was presented under the same, similar, or even different conditions. The conditions under which the content is presented, and that may be considered when predicting a response may include time of day, season, month, demographics of the user being presented with the content, behavior of the user being presented with the content, such as average view time, content consumption rate, along with other factors. This information regarding previous presentations of the content and the relevant conditions, along with resulting user responses may be provided to a predictive model. Later, the model may be queried to determine a likely response to another presentation of the content under a particular set of conditions. This information may then be utilized to determine a weight associated with the presentation of the content. Weights of at least two different content may be compared to determine which content is presented.

(53) FIG. **3** is a schematic diagram **300** illustrating data which may be stored in the database **120** of the messaging server system **108**, according to certain exemplary embodiments. While the content of the database **120** is shown to comprise a number of tables, it will be appreciated that the data could be stored in other types of data structures (e.g., as an object-oriented database).

(54) The database **120** includes message data stored within a message table **314**. An entity table **302** stores entity data, including an entity graph **304**. Entities for which records are maintained within the entity table **302** may include individuals, corporate entities, organizations, objects, places, events, etc. Regardless of type, any entity regarding which the messaging server system **108** stores data may be a recognized entity. Each entity is provided with a unique identifier, as well as an entity type identifier (not shown).

(55) The entity graph **304** furthermore stores information regarding relationships and associations between or among entities. Such relationships may be social, professional (e.g., work at a common corporation or organization), interested-based, or activity-based, merely for example.

(56) The database **120** also stores annotation data, in the example form of filters, in an annotation table **312**. Filters for which data is stored within the annotation table **312** are associated with and applied to videos (for which data is stored in a video table **310**) and/or images (for which data is stored in an image table **308**). Filters, in one example, are overlays that are displayed as overlaid on an image or video during presentation to a recipient user. Filters may be of varies types, including user-selected filters from a gallery of filters presented to a sending user by the messaging client application **104** when the sending user is composing a message. Other types of filters include geolocation filters (also known as geo-filters), which may be presented to a sending user based on geographic location. For example, geolocation filters specific to a neighborhood or special location may be presented within a user interface by the messaging client application **104**, based on geolocation information determined by a Global Positioning System (GPS) unit of the client device **102**. Another type of filter is a data filter, which may be selectively presented to a sending user by the messaging client application **104**, based on other inputs or information gathered by the client device **102** during the message creation process. Examples of data filters include a current temperature at a specific location, a current speed at which a sending user is traveling, a battery life for a client device **102**, or the current time.

(57) Other annotation data that may be stored within the image table **608** is so-called "lens" data. A "lens" may be a real-time special effect and sound that may be added to an image or a video.

(58) As mentioned above, the video table **310** stores video data which, in one embodiment, is associated with messages for which records are maintained within the message table **314**. Similarly, the image table **308** stores image data associated with messages for which message data is stored in the entity table **302**. The entity table **302** may associate various annotations from the annotation table **312** with various images and videos stored in the image table **308** and the video table **310**.

(59) A story table **306** stores data regarding collections of messages and associated image, video, or audio data, which are compiled into a collection (e.g., a SNAPCHAT story or a gallery). The creation of a particular collection may be initiated by a particular user (e.g., a user for whom a record is maintained in the entity table **302**). A user may create a "personal story" in the form of a collection of content that has been created and sent/broadcast by that user. To this end, the user interface of the messaging client application **104** may include an icon that is user-selectable to enable a sending user to add specific content to his or her personal story.

(60) A collection may also constitute a "live story," which is a collection of content from multiple users that is created manually, automatically, or using a combination of manual and automatic techniques. For example, a "live story" may constitute a curated stream of user-submitted content from various locations and events. Users whose client devices have location services enabled and who are at a common location or event at a particular time may, for example, be presented with an option, via a user interface of the messaging client application **104**, to contribute content to a particular live story. The live story may be identified to the user by the messaging client application **104**, based on his or her location. The end result is a "live story" told from a community perspective.

(61) A further type of content collection is known as a "location story," which enables a user whose client device **102** is located within a specific geographic location (e.g., on a college or university campus) to contribute to a particular collection. In some embodiments, a contribution to a location story may require a second degree of authentication to verify that the end user belongs to a specific organization or other entity (e.g., is a student on the university campus).

(62) FIG. **4** is a block diagram illustrating functional components of the content selection system **208** that forms part of the messaging system **100**, according to some example embodiments. To avoid obscuring the inventive subject matter with unnecessary detail, various functional components (e.g., modules, engines, and databases) that are not germane to conveying an understanding of the inventive subject matter have been omitted from FIG. **4**. However, a skilled artisan will readily recognize that various additional functional components may be supported by

the content selection system **208** to facilitate additional functionality that is not specifically described herein. As shown, the content selection system **208** includes a response probability component, a weight assignment component **404**, a content selection component **406**, and a presentation component **408**.

(63) The response probability component **402** may determine a probability that a user will respond to particular content with a particular type of input. In some aspects, the response probability component **402** may aggregate prior responses to the content and calculate the probability based on the agreed responses. In some aspects, the response probability component **402** may employ a model to predict probabilities of particular responses to presented content. In some aspects, the model may utilize machine learning techniques to generate the predictions. In some aspects, the machine learning may determine swipe rates and/or skip rates for particular content, as well as, in some aspects, time spent viewing the particular content. The machine learning may also determine a real time skip/swipe rate. The real time skip/swipe rate may be generated for a plurality of channels and/or a plurality of user demographics. The model may also consider a time of day the content will be presented. This may be correlated with historical results from similar times of day by the model.

(64) In some aspects, the model may weigh a plurality of input parameters differently when generating a probability value for a response to particular content. In some aspects, these parameters may be categorized broadly into three types. A first type of parameter relates to the presented content itself. A second type of parameter relates to a user being presented with the content. A third type of input parameters relates to a channel requesting the content. Channels may include, for example, user stories, local campus, or discovery. In some aspects, a channel requesting the content may indicate a location of the content. A fourth type of parameter relates to temporal aspects of the presented content. For example, a time of day the content is to be presented may be considered.

(65) Some aspects may determine a probability value based on a particular combination of input parameters to the model. For example, in some aspects, the probability value may be based on a combination of input parameters relating to the content itself, the user to which the content will be presented, the channel requesting the content, and/or temporal aspects of the presentation of the content.

(66) Examples of content specific parameters include a life time distribution channel swipe rate, distribution channel swipe rate, life time distribution channel skip rate, a total number of swipes, distribution channel skip rate, a life time number of swipes, a lifetime number of skips. In some aspects, content specific parameters may relate to inventory pools, such as publisher stories, our stories, and my stories. For example, the content specific parameter may indicate a source of the content.

(67) Examples of user specific parameters include swipe rate per month for the user, swipe count per month for the user, time viewed by the user, user's skip rate per month, user's skip count per month, and the user's time viewing each content presented.

(68) Examples of parameters specific to channels include the type of channel on which the content will be presented, and the time of day of the request.

(69) The weight assignment component **404** may assign weights to content. In some aspects, the weights may be assigned based on a probability assigned to the content by the response probability component **402**. In some aspects, the weights may be proportional to the probability. In other aspects, the weights may be assigned based on other factors discussed in more detail below.

(70) The content selection component **406** may select content for presentation from a plurality of candidate contents based in part, by weights assigned to the content by the weight assignment component **404**.

(71) The presentation component **408** may present media on an electronic display of a client device **102**. In some aspects, the presented media is an image file. In other aspects, the presented media

may be a video file. In some aspects, the presented media may be an installation dialog, such as a dialog enabling a user to install additional software on the client device. In some aspects, the presented media may be a web dialog.

(72) The above referenced functional components of the content selection system **208** are configured to communicate with each other (e.g., via a bus, shared memory, a switch, or APIs). Collectively, these components facilitate selective presentation of content to users.

(73) As is understood by skilled artisans in the relevant computer and Internet-related arts, each functional component illustrated in FIG. **4** may be implemented using hardware (e.g., a processor of a machine) or a combination of logic (e.g., executable software instructions) and hardware (e.g., memory and the processor of a machine) for executing the logic. For example, any component included as part of the content selection system **208** may physically include an arrangement of one or more processors **410** (e.g., a subset of or among one or more processors of a machine) configured to perform the operations described herein for that component. As another example, any component of the content selection system may include software, hardware, or both, that configure an arrangement of the one or more processors **410** to perform the operations described herein for that component. Accordingly, different components of the content selection system **208** may include and configure different arrangements of such processors **410** or a single arrangement of such processors **410** at different points in time.

(74) Furthermore, the various functional components depicted in FIG. **4** may reside on a single machine (e.g., a client device or a server) or may be distributed across several machines in various arrangements such as cloud-based architectures. Moreover, any two or more of these components may be combined into a single component, and the functions described herein for a single component may be subdivided among multiple components.

(75) FIG. **5**A is an illustration of competitive bidding for presentation of content during two presentation opportunities **421***a-b*. Prior to introduction of the disclosed methods and systems, brand advertisers and direct advertisers competed directly. Thus, an impressions quality played no role in a price determined by the advertiser. Thus, a direct response advertiser had no power to discriminate between good impressions (those with a high percentage of desired results) and bad impressions (those with a relatively lower percentage of desired results). Thus, if a direct response advertiser assessed a value of $1 for a desired response to an advertisement, and an average positive response rate to an advertisement is two (2) percent, the advertiser cannot pay more than $0.02 per impression.

(76) FIG. **5**A shows two entities **420***a-b* bidding for presentation of content during four opportunities **422***a-d*. Each of entities **420***a-b* bids for content presented during each of opportunities **422***a-d*. Because entity **420***a* has knowledge only that in general, a positive response rate is 2%, the entity **420***a* is only able to bid a maximum of $0.02 per opportunity, even though opportunities **422***a-b* have a higher probability of a positive result (e.g. swipe) than opportunities **422***c-d*. Entity **420***a* is unaware of this difference in probabilities between opportunities **422***a-b* and opportunities **422***c-d*, and thus is unable to modify its bid accordingly. Entity **420***b* is similarly positioned, but bids $0.02 for different reasons than entity **420***a*. Entity **420***b* may bid $0.02 not due to an expected response rate for the opportunities **422***a-d*, but instead based on a value of impressions made during the opportunities **422***a-d* to the entity **420***b*.

(77) FIG. **5**B shows an alternative embodiment relative to the embodiment of FIG. **5**A. In the embodiment of FIG. **5**B, the two entities **420***a-b* may each be provided with information relating to the probability that a particular result may occur within the opportunities **442***a-d*. As such, one or more of the entities may change their maximum bid in response to the differing probabilities. For example, FIG. **5**B shows that entity **420***a*, which may be a direct response advertiser, may bid a higher amount for a presentation during opportunity **442***a-b*, as a higher probability of a positive event (swipe) is associated with these opportunities when compared to opportunities **442***c-d*. Entity **420***b* may not change its bid across opportunities **442***a-d*, as entity **420***b* may be less sensitive to

user responses to its presentations of content.

(78) FIG. **5**C is a data flow diagram for an exemplary embodiment. The data flow **500** shown in FIG. **5**C includes a sequence of content **550**. The content sequence **550** may be displayed on an electronic display, such as an electronic display of a client device **102**, discussed above with respect to FIG. **1**. The content sequence **550** includes content **510**a-d displayed in user interfaces **512**a-d respectively. Each of the user interfaces **512**a-d may accept at least two types of content. A first type of input **554**a-d is shown for each of the user interfaces **512**a-d respectively. The first type of input **554**a-d may indicate a request to advance the sequence **550** (e.g. a swipe). The content **510**a-b and **510**d may be obtained from an event gallery or story in some aspects.

(79) The messaging system **100** may determine to insert additional content into the sequence of content **510**a-b and **510**d. The messaging system **100** may select between a plurality of candidate content before determining which particular content to insert after content **510**b. For example, the messaging system **100** may select between at least candidate content **510**$c1$ and **510**$c2$.

(80) In some aspects, the response probability component **402**, described above with respect to FIG. **4**, may determine a probability of response of a certain type for each of the content **510**$c1$ and content **510**$c2$. For example, the candidate content **510**$c1$ and content **510**$c2$ may be presented in a user interface than can accept at least two types of input. As described above, the first type of input may indicate a request to advance the sequence of content **550**. A second type of input may indicate a different action. For example, the second type of input may indicate a request to transition to a different sequence of content (i.e. different than sequence **550**). The response probability component **402** may determine a probability that a user viewing the candidate content **510**$c1$ and/or **510**$c2$ will provide input of the first and/or second type.

(81) The probability of each input type (or response) may be determined based on information obtained from a historical response database **600**. The historical response database **600** may provide aggregated information on responses received from prior presentations of content, such as candidate content **510**$c1$ and **510**$c2$. For example, the response database **600** may store response information indicating a type of input or response received for multiple previous presentations of the candidate content **510**$c1$ and/or **510**$c2$. The historical response database **600** is discussed in more detail with respect to FIG. **6**A below. Based on the types of previous input or responses received for particular content, such as candidate content **510**$c1$ and **510**$c2$, the response probability component **402** may determine a probability of a particular input or response being received if/when candidate content **510**$c1$ and/or **510**$c2$ is presented or displayed to the user.

(82) This probability information, shown as "P=x" and "P=y" respectively, is provided to the weight assignment component **404**. The weight assignment component **404** may assign weights W**1** and W**2** to each of the candidate content **510**$c1$ and **510**$c2$ respectively. The weights W**1** and W**2** may be assigned based at least in part on the probability information provided by the response probability component **402**. In some aspects, the weights may equal the probabilities. In other aspects, the weight assignment component may consider multiple other factors when determining a weight to assign to each of the candidate content. For example, factors relating to the content itself may be considered when determining a weight to assign to each of the candidate content **510**$c1$ and **510**$c2$.

(83) The weights W**1** and W**2** are provided to the content selection component **406**. The content selection component **406** then selects which content to present within the media sequence **550** based on the weights.

(84) The selected content **510**c is then presented as part of the sequence **550** by the content selection component **406**. The selected content **510**c (which is derived from either content **510**$c1$ or content **510**$c2$) may be presented in a user interface **512**c that is configured to accept the at least two types of input or response. For example, user interface **512**c, shown displaying the selected content **510**c, in FIG. **5**C, is configured to accept at least a swipe left input **554**c as the first type of input and a swipe up input **552** as the second type of input. Information relating to the type of input

received by the user interface **512***c* is then provided to the database **600**. For example, information relating content **510***c* to either input **554***c* or input **552** may be provided to the database **600**, depending on which input is provided by a user viewing the content **510***c*.

(85) FIGS. **6**A-B show a historical response database **600** and a content database **625** respectively. In some aspects, the databases **600** and/or **625** may be included in the database **300**, discussed above with respect to FIG. **3**.

(86) The historical response database includes a content identification column **602**, an impressions count column **604**, a first type of response count **606** and a second type of response count **608**. The impressions count **604** may provide a count of the number of times a particular content was presented on a display of a user of the messaging system **100**. The first type of response count **606** may provide a count of a number of times a first type of response was received in response to presentation of the content identified by the content id column **602**. For example, as discussed above with respect to FIG. **5**C, the first type of response may indicate a request to advance a sequence of content, such as the sequence of content **500** discussed above with respect to FIG. **5**C. The second type of response count column **608** may provide a count of how many times a second type of response was provided in response to presentation of the content identified by the content identification column **602**. The historical database **600** may be utilized by the response probability component **402** to compute a probability of the first type of response and the second type of response for a particular content. For example, as discussed above with respect to FIG. **5**C, the historical database **600** may be utilized to determine probability indications for the content **510***c*1 and/or **510***c*2, shown in FIG. **5**C as p=x and p=y respectively.

(87) The counts **604**, **606**, and/or **608** may be updated in response to input being received by the user interface **512***c*. For example, as shown in FIG. **5**C, the first type of input **554***c* may be provided to the user interface **512***c*. Alternatively, the second type of input **552** may be provided to the user interface **512***c*. Depending on the type of input provided to the user interface **512***c*, the appropriate count **606** or **608** may be incremented. The impression count **604** may also be incremented.

(88) The content database **625** stores content that may be inserted into a sequence of content, such as sequence **550**, discussed above with respect to FIG. **5**C. The content database **625** includes a content identification column **630**, content column **632**, and a factor column **634**. The content id **630** and content id **602** may store the same identifier if the same content is referenced in both rows of the historical database **600** and content database **625**. The content column **632** may store data that defines the content. For example, if the content is a video, the content column **632** may store the video data (and audio data if audio data is included as part of the video). If the content is a fixed image such as a photo, the content column **632** may store image data defining the photo (such as a jpeg file).

(89) The factor **634** is associated with the content identified by the content id column **630**. In some aspects, the factor **634** may be defined at the time the content **632** is created. In some aspects, the factor **634** may be adjusted over time. In some aspects, the factor **634** may be utilized in combination with the probability determined by the response probability component **402** to determine whether the content is selected for presentation.

(90) FIGS. **7**A-B show two exemplary relational database schemas. First, FIG. **7**A shows a relational historical results database **700**. FIG. **7**A shows one row **701** of the historical results database **700**. One of skill would understand that the database **700** may include a plurality of rows **701**. Each row **701** may represent a single presentation of content. The row **701** may also represent a response provided by a user in response to the presentation of the content. Each row **701** of the database **700** of FIG. **7**A includes a time **702**, user identifier **704**, content identifier **706**, view time **708**, channel **710**, and input type **712**.

(91) The time column **702** stores the time of day in which the content was presented. User id column **704** stores a unique identifier of a user of the messaging system **100**. The user identified in

user id column **704** identifies a user to which the content was presented. Content identification column **706** identifies the content presented. The content identification **706** column may be equivalent to content identification included in the databases **600** and/or **625**, discussed above. The content identification **706** column identifies the content associated with the particular row **701** of the database **700**. The view time **708** column stores an amount of time the user viewed the content identified by the content id **706** column during the presentation represented by the row **701**. The channel **710** indicates a channel on which the content was presented. The input type **712** stores a type of input provided by the user in response to the content identified by content id **706**.

(92) Some aspects may aggregate particular rows **701** of the database **700** to determine a probability that a particular content will provide a particular type of response. In some aspects, the database **700** may be used to generate the database **600**, discussed above. For example, rows **701** having a content id **706** of a particular value may be aggregated to form a single row of the database **600**. The single row may also include a content id **602** equivalent to the particular value. In some aspects, only rows **701** meeting certain other criteria may be aggregated.

(93) FIG. 7B illustrates an exemplary user database **750**. Each row **751** of the user database **750** includes a user id **752**, user name **754**, age **756**, sex **758** of the user. Other user characteristics **760** may also be stored in each row **751**. The user identifier **752** may provide a unique identifier for a user of the messaging system **100**. The user id **752** and user id **704** fields may store equivalent values. For example, the user id field **704** may identify a user described by a row **751** of the user database **751** and identified by the user id field **752**.

(94) In some aspects, data within rows **701** of the database **700** may be aggregated based on characteristics of a user identified by the user id field **704**. For example, view time **708** across users sharing some characteristics may be aggregated. For example, in some aspects, only select data within rows **701** for users within a particular age range or sex may be aggregated. Whether a particular user identified by the user id field **704** is within a particular age range may be determined via the user database **750**. For example, if the user id **704** matches the user id **752**, the corresponding age value **756** indicates the age of the user identified by the user id **704**. In some aspects, only rows **701** of the database **700** of users of a particular sex may be aggregated. The sex may be identified in a similar manner as the age range described above, by using the sex field **758** of the database **751**.

(95) FIG. **8**A is a flowchart of a method for displaying content on an electronic display. In some aspects, the process **800** discussed below with respect to FIG. **8**A may be performed by the client device **102**, discussed above with respect to FIG. **1**. In some aspects, one or more of the functions discussed below may be performed by the processor **410**, discussed above with respect to FIG. **4**. For example, one or more of the response probability component **402**, weight assignment component **404**, content selection component **406**, and/or presentation component **408** may store instructions that configure one or more processor **410** to perform one or more of the functions discussed below with respect to FIG. **8**A. In some aspects, one or more of the functions discussed below with respect to FIG. **8**A may be performed by the machine **1900**, discussed below with respect to FIG. **19**. For example, in some aspects, instructions **1910** may configure the processor **1904** to perform one or more of the functions discussed below. In some aspects, process **800** may be preceded by a presentation of portions of a sequence of content. For example, as shown in FIG. 5C, user interfaces **512***a-b* may present content **510***a-b.*

(96) In block **805**, a first session is established for a first user. The first session may be established, for example, via credentials for the first user such as a user account name and a password. Block **805** may compare user account information (e.g. name and password) received via a user interface and compare it to information stored in a user account database to determine if the session is to be established. Once the session is established, access to information about the user may be available. For example, information relating to characteristics of the user may be available, such as the user's age, gender, address, education level, history of behavior using the social network, and other

characteristics that may provide for some level of prediction as to how the user may behave in the future. A user id may also be available for the first user after establishment of the session. For example, a system performing process **800** may identify a user id, such as the user id **704** or **752** discussed above.

(97) In block **810**, a first probability of response for a first content by the first user is determined. For example, in some aspects, block **810** may determine a probability of a response of a first type to the first content. In some aspects, block **810** may determine a second probability of a response of a second type to the first content. As discussed above, in some aspects, the response probability component **402** may determine a probability of response based on the response database **600**. In some aspects, the probability may be based on historical responses to the first content. In some aspects, the probability may be determined via equation 1 below:

(98) $P_t C$ = numresponsesoftype$t$ / totalpresentationsof$C$, (1) where: P.sub.t=probability that a response of type t will be provided C=particular content

(99) In some aspects, the number of responses of type t may be stored in the historical response database **600**, discussed above with respect to FIG. **6**A. For example, the column **606** may store a count of the number of responses of a first type, while the column **608** may store a count of a number of responses of a second type. The impressions count **604** of the database **600** may store the total number of presentations of content C, which may be utilized in equation (1) above.

(100) In some aspects, block **810** may employ machine learning to determine the first probability. As described above with respect to the response probability component **402**, machine learning may be utilized to generate the first probability. To that end, a variety of input parameters may be provided to a model, and the model may generate the first probability based on correlations between the input parameters and historical results, such as those stored in the historical result database **700**. An example of input parameters for a model utilized to generate the first probability, and weightings for the input parameters is shown below in FIG. **8**B. FIG. **20** provides one exemplary dataflow of one embodiment of using machine learning to determine the first probability.

(101) In block **820**, a second probability of response is determined for a second content. In some aspects, block **820** may determine a first probability that a response of a first type (such as a swipe left) may be received in response to presentation of the second content. In some aspects, block **820** may determine a second probability that a response of a second type (such as a swipe up) will be received in response to presentation of the second content. As illustrated above in FIG. **5**C, the response probability component may determine response probabilities for content. In some aspects, block **820** may utilize Equation 1, discussed above, to determine the response probability for the second content. For example, the historical response database **600** may include a row for the second row for the second content. Thus, the first type of response count **606** in the row may provide a number of times the first type of response has been received for the second content. The second type of response count **608** in the second row may provide a number of times the second type of response has been received for the second content. The impressions count **604** in the second row may store a total number of times the second content has been presented or displayed. In some aspects, this information, in combination with Equation 1 above, may be used to determine a probability of response for the second content.

(102) In some aspects, block **820** may employ machine learning to determine the second probability. As described above with respect to the response probability component **402**, a variety of input parameters may be provided to a model, and the model may generate the probability based on correlations between the input parameters and historical results, such as those stored in the historical result database **700**. An example of input parameters for a model utilized to generate the second probability, and weightings for the input parameters are shown below in FIG. **8**B. FIG. **20** describes an exemplary dataflow of an embodiment that uses a model to provide probabilities that a

first and/or second type of input will be received in response to presentation of particular content.

(103) In block **830**, a first factor associated with the first content is determined. In some aspects, the first factor may be obtained from the content database **625**. For example, the factor **634** may store a value for the factor for content identified by the content identifier **630**.

(104) In block **840**, a second factor associated with the second content is determined. As with the first factor for the first content, the second factor may be obtained from the content database **625** in some aspects. For example, the content database **625** may include a first row for the first content and a second row for the second content. The factor **634** in the second row may store a value of the second factor for the second content, while the factor **634** in the first row may store a value of the first factor for the first content.

(105) In block **850**, content is selected for display based on the first and second probabilities and the first and second factors. In some aspects, the first probability is multiplied by the first factor to determine a first weight. In some of these aspects, the second probability is multiplied by the second factor to determine a second weight. The selection may be performed based on a comparison of the first and second weights in some aspects. For example, content with the highest weight may be selected in some aspects. In other aspects, content with the lowest weight may be selected. In still other aspects, other considerations, in addition to the first and second weights, may be considered when selecting between the first and second content.

(106) In block **860**, the selected content is displayed. For example, as described above with respect to FIG. **5**C, a first content **510***c***1** and a second content **510***c***2** may be analyzed. The content selection component **406** may select one of the content **510***c***1** and **510***c***2** to select content **510***c*, which is presented for display as part of the sequence **550**. The selected content may be include in a user interface, such as user interface **512**, which provides for at least two types of input. The first type of input indicates a request to continue the sequence of content. For example, reception of the first type of input **554***c* may indicate a request to continue the sequence **550** and display content **510***d* in user interface **512***d*.

(107) Selecting which content is displayed may have substantial technical effects on a social networking system. For example, each content may facilitate different types of user interactions. A first content may allow a user to play a video. A second content may allow a user to add a friend relationship within the social network. A third content may launch a 3.sup.rd party application. The 3.sup.rd party application, may, for example, schedule an autonomous vehicle to pick up the first user at a location indicated by the client device of the first user. Another content may allow a user to adjust settings on their mobile device.

(108) FIG. **8**B shows an exemplary weighting of input parameters to a model for determining one or more of the first and second probabilities discussed above with respect to blocks **810** and/or **820** of process **800**. The input parameters to the model may include a life time distribution channel swipe rate for the content, a distribution channel swipe rate for the content, a swipe rate for a month by the user, a lifetime distribution channel skip rate for the content, a swipe count for a previous month for the content, a total number of swipes for the content, an amount of time a user has viewed content within the past 30 days, a distribution channel skip rate for the content, a skip rate per month for the user, a lifetime number of swipes for the content, a number of skips the user has performed in the preview month, a number of times the content has been skipped by all users, a number of times the user has viewed content in the past 30 days, a life time number of skips for the content, whether the content is displayed over a discovery channel, a time of day or day of week or month in which the content is displayed.

(109) FIG. **9** is a flowchart for an exemplary method of aggregating statistics for presentation of particular content. The particular content may potentially be presented to a particular user, and the presentation of the content may have been requested by a particular channel. In some aspects, the process **900** discussed below with respect to FIG. **9** may be utilized by one or more of blocks **810** and/or **820**, discussed above with respect to FIG. **8**A. For example, block **810** and/or **820** may

aggregate historical results for prior presentations of particular content, in order to predict the likelihood of a particular result when that content is presented again. The particular content may have a particular identifier that identifies it. This identifier may be the content identifier discussed above with respect to the databases **600**, **625**, and **700**. In some aspects, a prediction model may be used for determining the probabilities of blocks **810** and/or **820**. The model may incorporate at least portions of process **900**, and may also incorporate additional factors not reflected in the exemplary method of process **900** discussed below.

(110) In some aspects, prior presentations of content sharing characteristics of the particular content may be considered by process **900**. In some aspects, only presentations to users sharing one or more characteristics with the particular user to which the subject content will be presented are considered by process **900**. In some aspects, only presentations to channels similar or equivalent to the particular channel requesting the presentation will be considered. For example, in some aspects, a probability that a user within a certain age range or gender will respond in a particular way is determined by blocks **810** and/or **820**. In these aspects, process **900** may filter out historical entries for users not matching the desired criteria.

(111) Process **900** may determine a total number of presentations of a particular content. This information may be stored, in some aspects, in the impressions count column **604**, discussed above with respect to database **600**. Process **900** may also determine, of the total number of impressions, how many generated a response of a particular type. For example, process **900** may determine how many presentations generated responses of a first type and/or of a second type. This information may be stored in one or more of the first type of response count **606**, and/or the second type of response count **608**, as discussed above with respect to FIG. **6**A and database **600**.

(112) In block **905**, an entry or row of a historical results database is read. In some aspects, the historical results database may take the form of the historical results database **700**, discussed above with respect to FIG. **7**A.

(113) Decision block **910** determines whether the entry in the historical results database is for the particular content process **900** is aggregating. If not, process **900** moves to decision block **960**. If the entry is for the particular content, process **900** moves from decision block **910** to decision block **925**, which determines whether the presentation of the content matches one or more criteria. For example, in some aspects, probability determinations may be based on prior presentation results obtained for content having similarities to the particular content, presentation results for users sharing one or more characteristics with the particular user, and prior presentation to channels sharing one or more characteristics with the particular channel If the presentation of the particular content identified in block **905** does not match the specific conditions relating to one or more of the content, the user, and/or the channel, then the current entry is not considered and process **900** moves to block **960**. Otherwise, a presentation counter is incremented in block **930**. In some aspects, block **930** may increment a presentation counter stored in the impressions count field **604**, discussed above with respect to database **600**.

(114) Decision block **940** determines whether a result of the presentation of the content identified in block **905** was a first type of response. If it was, then process **900** moves to block **950**, which increments a counter associated with the first type of response. In some aspects, block **950** may increment the first type of response count **606**, discussed above with respect to FIG. **6**A.

(115) If the response was not the first type, then process **900** moves to block **955**, which increments a second type of result counter. For example, in some aspects, block **955** may increment the second type of response count **608**, discussed above with respect to FIG. **6**A.

(116) Block **960** determines if there are additional entries (rows) in the historical response database. If so, processing returns to block **905**. Otherwise, processing continues below.

(117) FIGS. **10**A-B show results of one implementation of a prediction model utilized by the disclosed methods and systems. Graph **1000** shows two graphs, a log loss graph **1000** and an area under a receiver operative characteristics curve (AUROC). An x-axis for each of the graphs **1000**

and **1050** may represent a number of entries. In some aspects, this may reflect a number of trees utilized for the model. In some aspects, a random forest may be utilized in the model. In some aspects, ten (10) trees having eight (8) depths may be utilized. As the curve moves to the right in the two graphs, more entries are utilized, representing increasing model complexity.

(118) Graphs **1000** and **1050** show training data **1010** and **1070** respectively, and testing data **1020** and **1060** respectively. As an area under the receiver operative characteristics curve increases, one may consider that the measured model is doing a better job differentiating positive and negative examples. As shown by graphs **1000** and **1050**, log loss and AUROC may change at different rates. This may occur, in some aspects, when a model improves with respect to one area, but not another. The two areas may affect the scores in log loss and AUROC differently. As shown by graph **1000**, the training data **1010** exhibits lower log losses than the testing data **1020**. In contrast to the data shown in graph **1000**, in graph **1000**, the training data **1060** exhibits greater log losses than the testing data **1070**.

(119) FIG. **11** is an exemplary receiver operating characteristic curve. As the area under the curve increases, the precision of a model generating the curve is improving.

(120) FIG. **12** is an exemplary precision recall curve for one implementation of a model utilized in the disclosed systems and methods.

(121) FIG. **13** shows a calibration of a prediction model utilized by some of the disclosed methods and systems. The predictions made by the model compare favorably to actual results with lower mean predicted values. As the mean predicted value increases, differences between the predicted value and action results begin to diverge. Calibration effectively captures how "accurately" a model is performing. For example, if over the course of 1000 impressions, the model predicted **100** swipes (we sum all swipe-probabilities over these 1000 impressions), the calibration of the model may be measured by determining a number of swipes that actually occurred. If **100** swipes resulted from the 1000 impressions, the model used for the predictions would be perfectly calibrated.

(122) FIGS. **14**A-D show four graphs **1400***a-d* respectively, the graphs showing data that may be monitored and utilized by some models of the disclosed methods, devices, and systems. Graph **1400***a* shows that an amount of money spent per day may be monitored. Graph **1400***b* shows that a number of daily impressions may be monitored. Graph **1400***c* shows that a number of impressions tracked may be monitored. In other words, results of impressions may be tracked to determine whether the results of impressions are lining up well with predictions made by the model. Graph **1400***d* shows that a number of swipes in response to content provided may be tracked.

(123) FIGS. **15**A-B show two graphs **1500***a-b* respectively. Graph **1500***a* shows a first line graph **1510** showing a sum of swipe probabilities predicted by a particular time of day. A second line graph **1520** shows a number of swipes performed by a particular time of day. If the first line graph **1510** and second line graph **1520** were to match exactly, a model providing the predictions of the first line graph **1510** would be perfectly calibrated. The graph **1500***a* shows that the first and second line graphs diverge to some extent. This divergence is represented by a third line graph **1530** showing calibration of the model providing the swipe predictions.

(124) Graph **1500***b* includes a line graph **1540** showing calibration of the model over time. A calibration value of 1.0 represents a perfectly calibrated model. Graph **1500***b* shows the model converging toward a perfect calibration as results accumulate and the model is refined.

(125) FIG. **16** shows results of the disclosed methods, systems, and devices. Graph **1600** shows that as a user's frequency of swipes increases, bid prices for that user also increase. This demonstrates that the disclosed methods, systems, and devices are providing higher value for presentations of content to users that are more likely to swipe.

(126) FIG. **17**A shows a graph **1750** of bid prices for presentation of content. FIG. **17**B shows a graph **1700** of actual prices paid for presentation of content.

(127) Software Architecture

(128) FIG. **18** is a block diagram illustrating an example software architecture **1806**, which may be

used in conjunction with various hardware architectures herein described. FIG. **18** is a non-limiting example of a software architecture and it will be appreciated that many other architectures may be implemented to facilitate the functionality described herein. The software architecture **1806** may execute on hardware such as a machine **1900** of FIG. **19** that includes, among other things, processors **1804**, memory/storage **1806**, and I/O components **1818**. A representative hardware layer **1852** is illustrated and can represent, for example, the machine **1900** of FIG. **19**. The representative hardware layer **1852** includes a processing unit **1854** having associated executable instructions **1804**. The executable instructions **1804** represent the executable instructions of the software architecture **1806**, including implementation of the methods, components, and so forth described herein. The hardware layer **1852** also includes memory and/or storage **1856**, which also have the executable instructions **1804**. The hardware layer **1852** may also comprise other hardware **1858**.

(129) As used herein, the term "component" may refer to a device, a physical entity, or logic having boundaries defined by function or subroutine calls, branch points, APIs, and/or other technologies that provide for the partitioning or modularization of particular processing or control functions. Components may be combined via their interfaces with other components to carry out a machine process. A component may be a packaged functional hardware unit designed for use with other components and a part of a program that usually performs a particular function of related functions.

(130) Components may constitute either software components (e.g., code embodied on a machine-readable medium) or hardware components. A "hardware component" is a tangible unit capable of performing certain operations and may be configured or arranged in a certain physical manner. In various exemplary embodiments, one or more computer systems (e.g., a standalone computer system, a client computer system, or a server computer system) or one or more hardware components of a computer system (e.g., a processor or a group of processors) may be configured by software (e.g., an application or application portion) as a hardware component that operates to perform certain operations as described herein. A hardware component may also be implemented mechanically, electronically, or any suitable combination thereof. For example, a hardware component may include dedicated circuitry or logic that is permanently configured to perform certain operations.

(131) A hardware component may be a special-purpose processor, such as a Field-Programmable Gate Array (FPGA) or an Application-Specific Integrated Circuit (ASIC). A hardware component may also include programmable logic or circuitry that is temporarily configured by software to perform certain operations. For example, a hardware component may include software executed by a general-purpose processor or other programmable processor. Once configured by such software, hardware components become specific machines (or specific components of a machine) uniquely tailored to perform the configured functions and are no longer general-purpose processors. It will be appreciated that the decision to implement a hardware component mechanically, in dedicated and permanently configured circuitry, or in temporarily configured circuitry (e.g., configured by software) may be driven by cost and time considerations.

(132) A processor may be, or include, any circuit or virtual circuit (a physical circuit emulated by logic executing on an actual processor) that manipulates data values according to control signals (e.g., "commands," "op codes," "machine code," etc.) and that produces corresponding output signals that are applied to operate a machine. A processor may, for example, be a Central Processing Unit (CPU), a Reduced Instruction Set Computing (RISC) processor, a Complex Instruction Set Computing (CISC) processor, a Graphics Processing Unit (GPU), a Digital Signal Processor (DSP), an ASIC, a Radio-Frequency Integrated Circuit (RFIC), or any combination thereof. A processor may further be a multi-core processor having two or more independent processors (sometimes referred to as "cores") that may execute instructions contemporaneously.

(133) Accordingly, the phrase "hardware component" (or "hardware-implemented component") should be understood to encompass a tangible entity, be that an entity that is physically constructed, permanently configured (e.g., hardwired), or temporarily configured (e.g., programmed) to operate

in a certain manner or to perform certain operations described herein. Considering embodiments in which hardware components are temporarily configured (e.g., programmed), each of the hardware components need not be configured or instantiated at any one instance in time. For example, where a hardware component comprises a general-purpose processor configured by software to become a special-purpose processor, the general-purpose processor may be configured as respectively different special-purpose processors (e.g., comprising different hardware components) at different times. Software accordingly configures a particular processor or processors, for example, to constitute a particular hardware component at one instance of time and to constitute a different hardware component at a different instance of time. Hardware components can provide information to, and receive information from, other hardware components. Accordingly, the described hardware components may be regarded as being communicatively coupled. Where multiple hardware components exist contemporaneously, communications may be achieved through signal transmission (e.g., over appropriate circuits and buses) between or among two or more of the hardware components. In embodiments in which multiple hardware components are configured or instantiated at different times, communications between or among such hardware components may be achieved, for example, through the storage and retrieval of information in memory structures to which the multiple hardware components have access.

(134) For example, one hardware component may perform an operation and store the output of that operation in a memory device to which it is communicatively coupled. A further hardware component may then, at a later time, access the memory device to retrieve and process the stored output. Hardware components may also initiate communications with input or output devices, and can operate on a resource (e.g., a collection of information). The various operations of example methods described herein may be performed, at least partially, by one or more processors that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors may constitute processor-implemented components that operate to perform one or more operations or functions described herein. As used herein, "processor-implemented component" refers to a hardware component implemented using one or more processors. Similarly, the methods described herein may be at least partially processor-implemented, with a particular processor or processors being an example of hardware. For example, at least some of the operations of a method may be performed by one or more processors or processor-implemented components.

(135) Moreover, the one or more processors may also operate to support performance of the relevant operations in a "cloud computing" environment or as a "software as a service" (SaaS). For example, at least some of the operations may be performed by a group of computers (as examples of machines including processors), with these operations being accessible via a network (e.g., the Internet) and via one or more appropriate interfaces (e.g., an API). The performance of certain of the operations may be distributed among the processors, not only residing within a single machine, but deployed across a number of machines. In some exemplary embodiments, the processors or processor-implemented components may be located in a single geographic location (e.g., within a home environment, an office environment, or a server farm). In other exemplary embodiments, the processors or processor-implemented components may be distributed across a number of geographic locations.

(136) In the exemplary architecture of FIG. **18**, the software architecture **1806** may be conceptualized as a stack of layers where each layer provides particular functionality. For example, the software architecture **1806** may include layers such as an operating system **1802**, libraries **1820**, frameworks/middleware **1818**, applications **1816**, and a presentation layer **1814**. Operationally, the applications **1816** and/or other components within the layers may invoke API calls **1808** through the software stack and receive a response as messages **1810**. The layers illustrated are representative in nature and not all software architectures have all layers. For example, some mobile or special-purpose operating systems may not provide a frameworks/middleware **1818**

layer, while others may provide such a layer. Other software architectures may include additional or different layers.

(137) The operating system **1802** may manage hardware resources and provide common services. The operating system **1802** may include, for example, a kernel **1822**, services **1824**, and drivers **1826**. The kernel **1822** may act as an abstraction layer between the hardware and the other software layers. For example, the kernel **1822** may be responsible for memory management, processor management (e.g., scheduling), component management, networking, security settings, and so on. The services **1824** may provide other common services for the other software layers. The drivers **1826** are responsible for controlling or interfacing with the underlying hardware. For instance, the drivers **1826** include display drivers, camera drivers, Bluetooth® drivers, flash memory drivers, serial communication drivers (e.g., Universal Serial Bus (USB) drivers), Wi-Fi® drivers, audio drivers, power management drivers, and so forth depending on the hardware configuration.

(138) The libraries **1820** provide a common infrastructure that is used by the applications **1816** and/or other components and/or layers. The libraries **1820** provide functionality that allows other software components to perform tasks in an easier fashion than by interfacing directly with the underlying operating system **1802** functionality (e.g., kernel **1822**, services **1824**, and/or drivers **1826**). The libraries **1820** may include system libraries **1844** (e.g., C standard library) that may provide functions such as memory allocation functions, string manipulation functions, mathematical functions, and the like. In addition, the libraries **1820** may include API libraries **1846** such as media libraries (e.g., libraries to support presentation and manipulation of various media formats such as MPEG4, H.264, MP3, AAC, AMR, JPG, and PNG), graphics libraries (e.g., an OpenGL framework that may be used to render 2D and 3D graphic content on a display), database libraries (e.g., SQLite that may provide various relational database functions), web libraries (e.g., WebKit that may provide web browsing functionality), and the like. The libraries **1820** may also include a wide variety of other libraries **1848** to provide many other APIs to the applications **1816** and other software components/modules.

(139) The frameworks/middleware **1818** provide a higher-level common infrastructure that may be used by the applications **1816** and/or other software components/modules. For example, the frameworks/middleware **1818** may provide various graphic user interface (GUI) functions, high-level resource management, high-level location services, and so forth. The frameworks/middleware **1818** may provide a broad spectrum of other APIs that may be utilized by the applications **1816** and/or other software components/modules, some of which may be specific to a particular operating system **1802** or platform.

(140) The applications **1816** include built-in applications **1838** and/or third-party applications **1840**. Examples of representative built-in applications **1838** may include, but are not limited to, a contacts application, a browser application, a book reader application, a location application, a media application, a messaging application, and/or a game application. The third-party applications **1840** may include an application developed using the ANDROID™ or IOS™ software development kit (SDK) by an entity other than the vendor of the particular platform, and may be mobile software running on a mobile operating system such as IOS™, ANDROID™, WINDOWS® Phone, or other mobile operating systems. The third-party applications **1840** may invoke the API calls **1808** provided by the mobile operating system (such as the operating system **1802**) to facilitate functionality described herein.

(141) The applications **1816** may use built-in operating system functions (e.g., kernel **1822**, services **1824**, and/or drivers **1826**), libraries **1820**, and frameworks/middleware **1818** to create user interfaces to interact with users of the system. Alternatively, or additionally, in some systems interactions with a user may occur through a presentation layer, such as the presentation layer **1814**. In these systems, the application/component "logic" can be separated from the aspects of the application/component that interact with a user.

(142) Exemplary Machine

(143) FIG. **19** is a block diagram illustrating exemplary components (also referred to herein as "modules") of a machine **1900**. In some aspects, the machine is configured to read instructions from a machine-readable medium (e.g., a machine-readable storage medium) and perform any one or more of the methodologies discussed herein. Specifically, FIG. **19** shows a diagrammatic representation of the machine **1900** in the example form of a computer system, within which instructions **1910** (e.g., software, a program, an application, an applet, an app, or other executable code) for causing the machine **1900** to perform any one or more of the methodologies discussed herein may be executed. As such, the instructions **1910** may be used to implement modules or components described herein. The instructions **1910** transform the general, non-programmed machine **1900** into a particular machine **1900** programmed to carry out the described and illustrated functions in the manner described. In alternative embodiments, the machine **1900** operates as a standalone device or may be coupled (e.g., networked) to other machines. In a networked deployment, the machine **1900** may operate in the capacity of a server machine or a client machine in a server-client network environment, or as a peer machine in a peer-to-peer (or distributed) network environment. The machine **1900** may comprise, but not be limited to, a server computer, a client computer, a personal computer (PC), a tablet computer, a laptop computer, a netbook, a set-top box (STB), a personal digital assistant (PDA), an entertainment media system, a cellular telephone, a smart phone, a mobile device, a wearable device (e.g., a smart watch), a smart home device (e.g., a smart appliance), other smart devices, a web appliance, a network router, a network switch, a network bridge, or any machine capable of executing the instructions **1910**, sequentially or otherwise, that specify actions to be taken by machine **1900**. Further, while only a single machine **1900** is illustrated, the term "machine" shall also be taken to include a collection of machines that individually or jointly execute the instructions **1910** to perform any one or more of the methodologies discussed herein.

(144) The machine **1900** may include processors **1904**, memory/storage **1906**, and I/O components **1918**, which may be configured to communicate with each other such as via a bus **1902**. The memory/storage **1906** may include a memory **1914**, such as a main memory, or other memory storage, and a storage unit **1916**, both accessible to the processors **1904** such as via the bus **1902**. The storage unit **1916** and memory **1914** store the instructions **1910** embodying any one or more of the methodologies or functions described herein. The instructions **1910** may also reside, completely or partially, within the memory **1914**, within the storage unit **1916**, within at least one of the processors **1904** (e.g., within the processor's cache memory), or any suitable combination thereof, during execution thereof by the machine **1900**. Accordingly, the memory **1914**, the storage unit **1916**, and the memory of the processors **1904** are examples of machine-readable media. In some aspect, the processors **410** and processors **1904** may be the same processors.

(145) As used herein, the term "machine-readable medium," "computer-readable medium," or the like may refer to any component, device, or other tangible medium able to store instructions and data temporarily or permanently. Examples of such media may include, but are not limited to, random-access memory (RAM), read-only memory (ROM), buffer memory, flash memory, optical media, magnetic media, cache memory, other types of storage (e.g., Electrically Erasable Programmable Read-Only Memory (EEPROM)), and/or any suitable combination thereof. The term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, or associated caches and servers) able to store instructions. The term "machine-readable medium" may also be taken to include any medium, or combination of multiple media, that is capable of storing instructions (e.g., code) for execution by a machine, such that the instructions, when executed by one or more processors of the machine, cause the machine to perform any one or more of the methodologies described herein. Accordingly, a "machine-readable medium" may refer to a single storage apparatus or device, as well as "cloud-based" storage systems or storage networks that include multiple storage apparatus or devices. The term "machine-readable medium" excludes transitory signals per se.

(146) The I/O components **1918** may include a wide variety of components to provide a user interface for receiving input, providing output, producing output, transmitting information, exchanging information, capturing measurements, and so on. The specific I/O components **1918** that are included in the user interface of a particular machine **1900** will depend on the type of machine. For example, portable machines such as mobile phones will likely include a touch input device or other such input mechanisms, while a headless server machine will likely not include such a touch input device. It will be appreciated that the I/O components **1918** may include many other components that are not shown in FIG. **19**. The I/O components **1918** are grouped according to functionality merely for simplifying the following discussion and the grouping is in no way limiting. In various exemplary embodiments, the I/O components **1918** may include output components **1926** and input components **1928**. The output components **1926** may include visual components (e.g., a display such as a plasma display panel (PDP), a light emitting diode (LED) display, a liquid crystal display (LCD), a projector, or a cathode ray tube (CRT)), acoustic components (e.g., speakers), haptic components (e.g., a vibratory motor, resistance mechanisms), other signal generators, and so forth. The input components **1928** may include alphanumeric input components (e.g., a keyboard, a touch screen configured to receive alphanumeric input, a photo-optical keyboard, or other alphanumeric input components), point-based input components (e.g., a mouse, a touchpad, a trackball, a joystick, a motion sensor, or other pointing instruments), tactile input components (e.g., a physical button, a touch screen that provides location and/or force of touches or touch gestures, or other tactile input components), audio input components (e.g., a microphone), and the like. The input components **1928** may also include one or more image-capturing devices, such as a digital camera for generating digital images and/or video.

(147) In further exemplary embodiments, the I/O components **1918** may include biometric components **1930**, motion components **1934**, environment components **1936**, or position components **1938**, as well as a wide array of other components. For example, the biometric components **1930** may include components to detect expressions (e.g., hand expressions, facial expressions, vocal expressions, body gestures, or eye tracking), measure biosignals (e.g., blood pressure, heart rate, body temperature, perspiration, or brain waves), identify a person (e.g., voice identification, retinal identification, facial identification, fingerprint identification, or electroencephalogram-based identification), and the like. The motion components **1934** may include acceleration sensor components (e.g., accelerometer), gravitation sensor components, rotation sensor components (e.g., gyroscope), and so forth. The environment components **1936** may include, for example, illumination sensor components (e.g., photometer), temperature sensor components (e.g., one or more thermometers that detect ambient temperature), humidity sensor components, pressure sensor components (e.g., barometer), acoustic sensor components (e.g., one or more microphones that detect background noise), proximity sensor components (e.g., infrared sensors that detect nearby objects), gas sensors (e.g., gas detection sensors to detect concentrations of hazardous gases for safety or to measure pollutants in the atmosphere), or other components that may provide indications, measurements, or signals corresponding to a surrounding physical environment. The position components **1938** may include location sensor components (e.g., a GPS receiver component), altitude sensor components (e.g., altimeters or barometers that detect air pressure from which altitude may be derived), orientation sensor components (e.g., magnetometers), and the like.

(148) Communication may be implemented using a wide variety of technologies. The I/O components **1918** may include communication components **1940** operable to couple the machine **1900** to a network **1932** or devices **1920** via a coupling **1924** and a coupling **1922** respectively. For example, the communication components **1940** may include a network interface component or other suitable device to interface with the network **1932**. In further examples, the communication components **1940** may include wired communication components, wireless communication components, cellular communication components, Near Field Communication (NFC) components,

Bluetooth® components (e.g., Bluetooth® Low Energy), Wi-Fi® components, and other communication components to provide communication via other modalities. The devices **1920** may be another machine or any of a wide variety of peripheral devices (e.g., a peripheral device coupled via a USB).

(149) Moreover, the communication components **1940** may detect identifiers or include components operable to detect identifiers. For example, the communication components **1940** may include Radio Frequency Identification (RFID) tag reader components, NFC smart tag detection components, optical reader components (e.g., an optical sensor to detect one-dimensional bar codes such as Universal Product Code (UPC) bar code, multi-dimensional bar codes such as Quick Response (QR) code, Aztec code, Data Matrix, Dataglyph, MaxiCode, PDF4111, Ultra Code, UCC RSS-2D bar code, and other optical codes), or acoustic detection components (e.g., microphones to identify tagged audio signals). In addition, a variety of information may be derived via the communication components **1940**, such as location via Internet Protocol (IP) geo-location, location via Wi-Fi® signal triangulation, location via detecting an NFC beacon signal that may indicate a particular location, and so forth.

(150) FIG. **20** is a data flow diagram of one exemplary method of training a model to provide for determining of one or more probabilities of one or more input types provided in response to presentation of particular content. FIG. **20** shows the historical database **600** discussed above. The historical database may include historical results of previous presentations of content. As discussed above. A model builder **2010** may read the historical database **600** to generate a model database **2020**. The model database **2020** may include data describing relationships between input types received in response to presented content, and the content's characteristics, user characteristics, temporal characteristics, and channel characteristics of the presentation.

(151) A classifier **2030** may then read the model data **2020** to determine a probability that a user will respond to particular content **2055**. For example, in some aspects, the classifier **2030** may determine a probability that a user responds with input of a first type **2040**. In some aspects, the classifier **2030** may determine a probability that a user responds with input of a second type **2050**. In some aspects, the probability **2040** and/or probability **2050** may be determined for each of the first and second content in blocks **810** and **820** respectively, discussed above.

(152) The classifier **2030** may base the determination of probabilities **2030** and/or **2040** based on characteristics of the potential presentation of content **2055**. As discussed above, characteristics considered include characteristics of the content itself **2060**, characteristics of the user to which the content will be presented **2070** (e.g. data available via user database **750**), characteristics of a channel **2080** over which the content may be presented (e.g. channel **710**), and/or temporal aspects of the content presentation **2090** (e.g. view time **708**).

(153) Where a phrase similar to "at least one of A, B, or C," "at least one of A, B, and C," "one or more of A, B, or C," or "one or more of A, B, and C" is used, it is intended that the phrase be interpreted to mean that A alone may be present in an embodiment, B alone may be present in an embodiment, C alone may be present in an embodiment, or any combination of the elements A, B, and C may be present in a single embodiment; for example, A and B, A and C, B and C, or A and B and C may be present.

(154) Changes and modifications may be made to the disclosed embodiments without departing from the scope of the present disclosure. These and other changes or modifications are intended to be included within the scope of the present disclosure, as expressed in the following claims.

Claims

1. A method comprising: identifying a first content item and a second content item; storing a historical database comprising a first column that stores a time of day in which a given content item of a plurality of content items was presented, a second column that stores a view time representing an amount of time the given content item was viewed, and a third column that identifies the given content item; estimating, based on the historical database, a plurality of probabilities of different types of input responses that will be received from a user in response to presenting the first and second content items to the user, the plurality of probabilities being computed in accordance with an expression defined as:

P.sub.tC=number of responses of type/total presentations of C; and where P.sub.t represents a probability that a response of type/will be provided for particular content C; and selecting, as a selected content item, either the first content item or the second content item based on bid amounts associated with a first entity and a second entity.

2. The method of claim 1, further comprising: causing transmission of a first of the plurality of probabilities of the different types of input responses to the first entity associated with the first content item; causing transmission of a second of the plurality of probabilities to the second entity associated with the second content item; determining that the first entity has changed a maximum bid amount in response to the first of the plurality of probabilities; determining that the second entity failed to change a bid amount based on the second of the plurality of probabilities; and presenting the selected content item on an electronic display.

3. The method of claim 1, further comprising: establishing a first session for the user based on first user authentication credentials, the plurality of probabilities comprising a first probability that the first content item will elicit a first type of the different types of input responses and another probability that the first content item will elicit a second type of the different types of input responses, the plurality of probabilities being estimated based on a time of day, season and month during which the first content item will be presented to the user.

4. The method of claim 2, further comprising: estimating the second of the plurality of probabilities that the second content item will elicit a given type of input response of the different types of input responses from the user, the plurality of probabilities obtained from a classifier trained based on the historical database of characteristics of users generating responses, characteristics of the plurality of content items, and characteristics of channels over which the plurality of content items were presented.

5. The method of claim 1, further comprising determining a first factor associated with the first content item and a second factor associated with the second content item, and determining a first weight and a second weight based on the first factor and the second factor, respectively.

6. The method of claim 5, wherein determining the first weight comprises multiplying the first factor and a first probability to obtain the first weight.

7. The method of claim 1, wherein a classifier is trained to generate the plurality of probabilities based on a plurality of input parameters comprising a life time distribution channel swipe rate for a given content item, a distribution channel swipe rate for the given content item, a swipe rate for a month by a given user, a lifetime distribution channel skip rate for the given content item, a swipe count for a previous month for the given content item, a total number of swipes for the given content item, an amount of time the given user has viewed given content item within a 30 day period, a distribution channel skip rate for the given content item, a skip rate per month for the given user, a lifetime number of swipes for the given content item, a number of skips the given user has performed in a preview month, a number of times the given content item has been skipped by a plurality of users who viewed the given content item, a number of times the given user has viewed given content item in the 30 day period, a life time number of skips for the given content item, and

an indication of whether the given content item is displayed over a particular channel and a time of day, day of week, or month in which the given content item is displayed.

8. The method of claim 1, further comprising: receiving input in response to presentation of the selected content item; categorizing the received input as either a first type of input or a second type of input; and updating a historical response database based on categorizing of the received input.

9. The method of claim 8, further comprising incrementing a total number of impressions for the selected content item in the historical response database in response to presentation of the selected content item.

10. The method of claim 9, wherein estimating the plurality of probabilities comprises determining the total number of impressions of the first content item and a number of responses to the first content item having the first type.

11. The method of claim 10, further comprising estimating a first probability by dividing the number of responses by the total number of impressions.

12. The method of claim 11, further comprising filtering the total number of impressions and the number of responses to those impressions and responses for the user having an age within a predetermined range.

13. The method of claim 1, wherein a classifier is trained to generate the plurality of probabilities based on a plurality of input parameters comprising a distribution channel swipe rate for a given content item, a total number of swipes for the given content item, a distribution channel skip rate for the given content item, a skip rate per month for a given user, a number of times the given content item has been skipped by a plurality of users who viewed the given content item, and a number of times the given user has viewed given content item in a 30 day period.

14. The method of claim 1, wherein the first content item facilitates a first type of user interaction, and wherein the second content item facilitates a second type of user interaction, the first type of user interaction comprising adding a friend relationship within a social network, the second type of user interaction comprising scheduling an autonomous vehicle to pick up the user at a location indicated by a device of the user.

15. A system comprising: one or more electronic hardware processors; an electronic hardware memory, operatively coupled to the one or more electronic hardware processors, and storing instructions that configure the one or more electronic hardware processors to perform operations comprising: identifying a first content item and a second content item; storing a historical database comprising a first column that stores a time of day in which a given content item of a plurality of content items was presented, a second column that stores a view time representing an amount of time the given content item was viewed, and a third column that identifies the given content item; estimating, based on the historical database, a plurality of probabilities of different types of input responses that will be received from a user in response to presenting the first and second content items to the user, the plurality of probabilities being computed in accordance with an expression defined as:

P.sub.tC=number of responses of type/total presentations of C; and where P.sub.t represents a probability that a response of type/will be provided for particular content C; and selecting, as a selected content item, either the first content item or the second content item based on bid amounts associated with a first entity and a second entity.

16. The system of claim 15, wherein the operations further comprise: establishing a first session for the user based on first user authentication credentials, the plurality of probabilities comprising a first probability that the first content item will elicit a first type of the different types of input responses and another probability that the first content item will elicit a second type of the different types of input responses, the plurality of probabilities being estimated based on a time of day, season and month during which the first content item will be presented to the user.

17. The system of claim 15, wherein a classifier is trained to generate the plurality of probabilities based on a plurality of input parameters comprising a distribution channel swipe rate for a given

content item, a total number of swipes for the given content item, a distribution channel skip rate for the given content item, a skip rate per month for a given user, a number of times the given content item has been skipped by a plurality of users who viewed the given content item, and a number of times the given user has viewed given content item in a 30 day period.

18. A non-transitory computer readable medium comprising instructions that when executed cause at least one hardware processor to perform operations comprising: identifying a first content item and a second content item; storing a historical database comprising a first column that stores a time of day in which a given content item of a plurality of content items was presented, a second column that stores a view time representing an amount of time the given content item was viewed, and a third column that identifies the given content item; estimating, based on the historical database, a plurality of probabilities of different types of input responses that will be received from a user in response to presenting the first and second content items to the user, the plurality of probabilities being computed in accordance with an expression defined as:

P.sub.tC=number of responses of type/total presentations of C; and where P.sub.t represents a probability that a response of type/will be provided for particular content C; and selecting, as a selected content item, either the first content item or the second content item based on bid amounts associated with a first entity and a second entity.

19. The non-transitory computer readable medium of claim 18, wherein the operations further comprise: establishing a first session for the user based on first user authentication credentials, the plurality of probabilities comprising a first probability that the first content item will elicit a first type of the different types of input responses and another probability that the first content item will elicit a second type of the different types of input responses, the plurality of probabilities being estimated based on a time of day, season and month during which the first content item will be presented to the user.

20. The non-transitory computer readable medium of claim 18, wherein the operations further comprise: establishing a first session for the user based on first user authentication credentials, the plurality of probabilities comprising a first probability that the first content item will elicit a first type of the different types of input responses and another probability that the first content item will elicit a second type of the different types of input responses, the plurality of probabilities being estimated based on a time of day, season and month during which the first content item will be presented to the user.