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Inventor(s)	Griffin; Michael et al.

Automatic data obfuscation

Abstract

A method of protecting user privacy online includes collecting, via a computer-based user data agent, user data generated by a user on a user device and identifying a first set of traits associated with the user data. The method further includes generating a user profile based on the first set of traits associated with the user data and generating an alternate persona defined by a second set of traits that is different from the first set of traits. The method further includes automatically performing online activities based on the alternate persona to produce artificial user data that obscures real user data.

Inventors: Griffin; Michael (Wayland, MA), Snell; Catherine Jean (Durham, NC), Kothari; Dhairya (Chicago, IL), Rader; Jason (Jacksonville, FL)

Applicant: Insight Direct USA, Inc. (Chandler, AZ)

Family ID: 1000008765240

Assignee: Insight Direct USA, Inc. (Chandler, AZ)

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Primary Examiner: Le; Thanh T

Attorney, Agent or Firm: Kinney & Lange, P.A.

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION (1) This application claims the benefit of U.S. Provisional Application No. 63/413,794, filed Oct. 6, 2022, and entitled “AUTOMATIC DATA OBFUSCATION,” the disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND

(1) The present disclosure relates generally to online user data generation and more specifically to systems and methods for obscuring online user data that is generated.

(2) Whenever someone uses the internet, such as via an application on their mobile device or via their browser, data can be collected by various entities (i.e., online providers or profilers) who may use or sell that data. Sometimes this is unavoidable if a user wants to take advantage of the functionality of an application, website, or other internet platform. For example, if a user wants to use a mobile application to listen to music, that user must accurately provide a selection of music to play, or they will not receive accurate results. However, now that data relating to the user's music preference (and potentially other insights) will be shared with the online provider for the application. Individual internet users generally have little to no control over how their data is used by an online provider or to whom it is sold, despite the personal nature of some of the data. In many cases, online providers maintain a “profile,” or a digital representation of a person, that defines the individual as a collection of certain data attributes. Any application, website, digital platform, etc. having data about the individual can sell it to an advertising company, who can then use that data to tailor advertisements to the individual. Although many applications allow a user to turn off personalized ads, this does not prevent companies from collecting data about the user.

SUMMARY

(3) In one example, a method of protecting user privacy online includes collecting, via a computer-based user data agent, user data generated by a user on a user device and identifying a first set of traits associated with the user data. The method further includes generating a user profile based on the first set of traits associated with the user data and generating an alternate persona defined by a second set of traits that is different from the first set of traits. The method further includes automatically performing online activities based on the alternate persona to produce artificial user data that obscures real user data.

(4) In another example, a system for protecting user privacy online includes a user device and a computer-based user data agent that includes one or more processors and computer-readable memory encoded with instructions that, when executed by the one or more processors, cause the computer-based user data agent to collect user data generated by a user on the user device and identify a first set of traits associated with the user data. The instructions further cause the computer-based user data agent to generate a user profile based on the first set of traits associated with the user data and generate an alternate persona defined by a second set of traits that is different from the first set of traits. The instructions further cause the computer-based user data agent to automatically perform online activities based on the alternate persona to produce artificial user data that obscures real user data.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. 1 is a schematic block diagram showing a user data system for producing real and artificial user data.

(2) FIG. 2 is a schematic block diagram showing details of a first example of generating and using alternate personas in the user data system.

(3) FIG. 3 is a schematic block diagram showing details of a second example of generating and

using alternate personas in the user data system.

(4) FIG. 4 is a flowchart illustrating steps of a process for protecting user privacy online.

(5) FIG. 5 is a flowchart illustrating steps of a process for tailoring online user sub-accounts.

DETAILED DESCRIPTION

(6) According to techniques of this disclosure, a user data system can generate both real and artificial user data and can include a computer-based user data agent for generating the artificial user data. The artificial user data can be used to obscure the real user data and/or to automatically tailor online sub-accounts within an overall user account on behalf of a user. The user data system disclosed herein and corresponding methods are described below with reference to FIGS. 1-5.

(7) FIG. 1 is a schematic block diagram showing user data system **10** for generating real and artificial user data. As illustrated in FIG. 1, user data system **10** includes user data agent **20**, user device **30**, and user **40**. User data agent **20** includes processor **52**, memory **54**, and user interface **56**. User data agent **20** further includes user profile generator module **60**, alternate persona generator module **62**, and online activity module **64**. User device **30** includes browser **70** and user accounts **72** (including user accounts **72A-72n**). As is further shown in FIG. 1, user data system **10** produces user data **80**, which includes real user data **82** and artificial user data **84**.

(8) User data system **10** is a system for generating both real and artificial user data. In one, non-limiting example, user data system **10** can be a data obfuscation system for obscuring real user data **82** with artificial user data **84**. In another example, user data system **10** can be a system for automatically generating artificial user data **84** to automatically tailor online sub-accounts within an overall user account on behalf of user **40**.

(9) User data agent **20** is a computer-based platform for defining and carrying out the functionality described herein. User data agent **20** can take the form of one or more computers, each including a processor and memory. In some examples, user data agent **20** can be implemented as a dedicated computer. In other examples, user data agent **20** can be implemented on a computer that makes up part of user device **30**. That is, user data agent **20** can include dedicated hardware or can include software that runs on client hardware. In some examples, user data agent **20** can be embodied in a mobile application that is downloaded to user device **30** and runs on user device **30**. In other examples, user data agent **20** can include a browser-based application that runs within browser **70** on user device **30**. In yet other examples, user data agent **20** can include a browser extension, such as an extension available from browser **70** or which could be directly downloaded from a web server and installed on user device **30**. In any such examples, user data agent **20** can also include a web server (not shown) for distributing code to the application or extension, which may include running an application programming interface (API) to connect to mobile applications. Moreover, although not shown in FIG. 1, user data agent **20** can include any suitable communication interface modules (software and/or hardware) for establishing communication with other components of user data system **10**, such as user device **30**. For example, the communication interface modules can account for authorization or security requirements for accessing data from user device **30** (e.g., from a password manager installed on user device **30**).

(10) User data agent **20** includes processor **52**, memory **54**, and user interface **56**. Although processor **52** and memory **54** are illustrated in FIG. 1 as being separate components of a single computer device, it should be understood that in other examples, processor **52** and memory **54** can be distributed among multiple connected devices. In other examples, memory **54** can be a component of processor **52**. Processor **52** is configured to implement functionality and/or process instructions within user data agent **20**. For example, processor **52** can be capable of processing instructions stored in memory **54**. Examples of processor **52** can include one or more of a processor, a microprocessor, a controller, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or other equivalent discrete or integrated logic circuitry.

(11) Memory **54** can be configured to store information before, during, and/or after operation of

user data agent **20**. Memory **54**, in some examples, is described as computer-readable storage media. In some examples, a computer-readable storage medium can include a non-transitory medium. The term “non-transitory” can indicate that the storage medium is not embodied in a carrier wave or a propagated signal. In certain examples, a non-transitory storage medium can store data that can, over time, change (e.g., in RAM or cache). In some examples, memory **54** can be entirely or partly temporary memory, meaning that a primary purpose of memory **54** is not long-term storage. Memory **54**, in some examples, is described as volatile memory, meaning that memory **54** does not maintain stored contents when power to devices (e.g., hardware of user data agent **20**) is turned off. Examples of volatile memories can include random access memories (RAM), dynamic random access memories (DRAM), static random access memories (SRAM), and other forms of volatile memories. Memory **54**, in some examples, also includes one or more computer-readable storage media. Memory **54** can be configured to store larger amounts of information than volatile memory. Memory **54** can further be configured for long-term storage of information. In some examples, memory **54** includes non-volatile storage elements. Examples of such non-volatile storage elements can include magnetic hard discs, optical discs, flash memories, or forms of electrically programmable memories (EPROM) or electrically erasable and programmable (EEPROM) memories.

(12) Memory **54** is encoded with instructions that are executed by processor **52**. For example, memory **54** can be used to store program instructions for execution by processor **52**. In some examples, memory **54** is used by software or applications running on processor **52** to temporarily store information during program execution.

(13) User interface **56** can be included as part of user data agent **20** to allow users **40** to interact with user data agent **20** in user data system **10**. For example, user interface **56** can allow users **40** to review, input, or update a user profile for user profile generator module **60**; to select, modify, or set preferences related to personas generated by alternate persona generator module **62**; to configure aspects of user data agent **20**, such as by setting permissions or limits for online activity module **64**, providing user data agent **20** with access to credentials for user accounts **72**, or other possible configurations; etc. In some examples, user interface **56** includes a graphical user interface (GUI) that includes graphical representations of information or steps for user **40** that are associated with user data agent **20**. For example, the GUI could include drop-down menus that list suggestions of alternate personas for user **40** to select from.

(14) User device **30** can be any device associated with user **40** that is capable of connecting to and communicating data using the internet. For example, user device **30** can take the form of a desktop computer, a laptop, a tablet, a smartphone, or any other similar device. In some examples, user device **30** is a mobile device. User device **30** includes browser **70**. Browser **70** is an internet browser for accessing websites on the World Wide Web or a local network. Browser **70** can be any internet browser that is available on the market, such as Google Chrome, Microsoft Edge, Firefox, Safari, etc., or can be a custom browser. User device **30** also includes user accounts **72**. User accounts **72** can represent any one or more user accounts **72A-72n** (“n” is used herein as an arbitrary integer to indicate any number of the referenced component) set up by user **40** through which user **40** can access online services from a respective online provider. User accounts **72** can also be referred to as online user accounts. To name a few non-limiting examples, user accounts **72** can be social media accounts (such as Twitter, Facebook, Instagram, etc.), streaming service accounts (such as YouTube, Netflix, Hulu, Spotify, etc.), or other similar account types. More generally, user accounts **72** can be described as online content service accounts that are associated with corresponding online content services. In some examples, one or more user accounts **72** may be accessed by logging in using a web page on browser **70**. In other examples, one or more user accounts **72** may be accessed by logging in to an application, such as a mobile application that is downloaded to user device **30**. User data **80** is generated from online activity on browser **70** and/or via user accounts **72**.

(15) User data agent **20** can be further defined as a set of functional modules. Although user data agent **20** is described herein as being divided into three modules, it should be understood that the functionality of user data agent **20** could also be described as more or fewer modules, which could depend, in some examples, on how the code is written or organized. As illustrated in FIG. **1**, user data agent **20** includes user profile generator module **60**, alternate persona generator module **62**, and online activity module **64**. User profile generator module **60**, alternate persona generator module **62**, and online activity module **64** will be described sequentially; however, these modules need not always be performed in any particular order and may also include overlapping or interspersed functionality.

(16) User profile generator module **60** is a first functional module of user data agent **20**. User profile generator module **60** can include methods in code for creating a baseline set of information about user **40** (i.e., a user profile). Whenever user **40** performs an online activity—such as browsing web pages or streaming videos, for example—user data is produced, and the online provider associated with each activity can collect the user data and create a respective user profile. Similarly, user profile generator module **60** can monitor the online behavior of user **40** and collect user data that is associated with these online activities; however, user profile generator module **60** monitors online behavior and collects user data on behalf of user **40**. In some examples, user profile generator module **60** can collect user data from all of the online behavior for user **40** (i.e., all applications, all web pages, etc.). In such cases, the user profile generated by user profile generator module **60** can be considered a generalized profile. In other examples, user profile generator module **60** may only collect user data from some of these online behaviors or from particular online platforms. In some examples, user **40** can identify a subset of online behaviors or platforms from which user profile generator module **60** should collect user data via an input to user interface **56**.

(17) User profile generator module **60** can collect user data associated with online activities of user **40** in several ways. In one example, user profile generator module **60** can analyze browser cookies stored on user device **30** that have been generated by online activities of user **40**. In another example, user profile generator module **60** can import information about user **40** from one or more user accounts **72A-72n**. In yet other examples, user **40** could manually input information into user profile generator module **60** via user interface **56**. Alternatively, user profile generator module **60** can mine user data from existing profilers. That is, user profile generator module **60** could request and receive a report with some or all the user data associated with user **40** that has already been collected by an online provider, and user profile generator module **60** could read in the information from this pre-existing profile. Any one or more of these techniques for collecting initial user data can be used independently or in combination by user profile generator module **60**.

(18) In any of these cases, user profile generator module **60** can derive and identify a first set of traits associated with the collected user data. The user data collected by user profile generator module **60** can encompass one or more traits or factors that characterize the online behavior of user **40**. The traits can represent different categories of information, such as age, sex, political affiliation, movie genre preference etc. Some of these categories may represent common values that are present in almost all user data. Deriving the first set of traits can involve predictive models for predicting traits based on the raw user data collected by user profile generator module **60**, data inference techniques (e.g., a user clicked on 50 articles about golf this year so the user must be a golfer), categorical determinations (sex, gender, age), or other techniques. Additionally, if a pre-existing profile from an online provider is available, deriving the first set of traits could also include developing a model that mirrors the data collection technique that was used to generate the pre-existing profile. User profile generator module **60** can also match or abstract the traits associated with user **40** to pre-defined clusters or groups of users (e.g., persons aged 18-25, football fans, etc.). In this way, comparisons can be made more easily between the user profile generated by user profile generator module **60** and alternate personas generated by alternate persona generator module **62**.

(19) The first set of traits and the clusters that the traits fit into define a user profile. Accordingly, user profile generator module **60** generates a user profile based on the first set of traits associated with the collected user data. The user profile can be automatically generated by user profile generator module **60** after the desired user data is collected.

(20) Alternate persona generator module **62** is a second functional module of user data agent **20**. Alternate persona generator module **62** can include methods in code for generating one or more alternate personas (e.g., personas **85**, as will be described in greater detail below in two examples with respect to FIGS. 2-3). In general, alternate personas can be defined by respective sets of traits that are different from the first set of traits that defines the user profile generated by user profile generator module **60**. Alternate persona generator module **62** can automatically generate one or more alternate personas, and the one or more of the alternate personas can be utilized by online activity module **64**. That is, in some examples, multiple alternate personas may be utilized simultaneously by online activity module **64**. As will also be described in greater detail below with respect to FIG. 2, alternate persona generator module **62** can generate multiple candidate personas, and one or more alternate personas can be selected from amongst the candidate personas. For example, user **40** can review the candidate personas and either directly select an alternate persona or can set parameters for selecting the alternate persona via user interface **56**. User **40** can set parameters such as desired traits, limitations on how the alternate persona will be used in online activity module **64**, etc. In other examples, user **40** can select traits (e.g., from pool of pre-defined common options) before alternate personas are generated to create customized alternate personas. In some examples, alternate personas can be generated primarily or entirely using common values, i.e., traits that can be sorted into categories that are common across many users. For example, if several applications all require users to enter their age and sex, then these would be common values that could be used to generate alternate personas. In such an example, one alternate persona that might be generated could be defined as “male over age 50,” another alternate persona could be defined as “female age 25-35,” and so on.

(21) There are several approaches that could be used to determine how different from the user profile an alternate persona should and/or will be. In general, the idea is that each alternate persona will be defined by a set of traits that is in some way different from the set of traits that defines the user profile. In one example, this could be accomplished by using a random selection of traits or clusters available from common options. The random traits are unlikely to be exactly the same as the traits associated with the user profile. In another example, alternate persona generator module **62** could determine what an average or median profile would be, identify its traits, and generate an alternate persona based on the traits associated the average or median profile. In other examples, alternate persona generator module **62** can use the user profile generated by user profile generator module **60** as a starting point and then make changes away from the derived traits that define the user profile. This could also be accomplished in several different ways. In one example, alternate persona generator module **62** could create random differences in the traits associated with the user profile to develop an alternate persona with a new set of traits. In another example, alternate persona generator module **62** could identify key traits associated with the user profile and then intelligently generate an alternate persona that differs in those key traits. In yet another example, alternate persona generator module **62** could evaluate an existing pool of traits or clusters to identify opposite traits and generate an alternate persona based on traits that are opposite from the traits that define the user profile (i.e., an “anti-” or “counter-” persona). In some examples, specific anti-personas could be targeted against individual pre-existing profiles put together by profilers.

(22) Alternate persona generator module **62** can also include machine learning techniques to train and develop models for intelligently generating alternate personas. From a practical standpoint, a machine learning-based model for alternate persona generator module **62** could ultimately change the code for user data agent **20**, and any code updates would need to be pushed to application or browser extension versions of user data agent **20**. In an implementation of alternate persona

generator module **62** that uses machine learning, a model could be trained using the user profile generated by user profile generator module **60**. A model could also be trained using a set of sample user profiles or clusters of data (e.g., anonymized/de-identified data available from data brokers). Trained models could then be used to populate alternate personas with traits and/or clusters of traits to intelligently generate more sophisticated alternate personas. Some examples of alternate persona generator module **62** can function similar to a generative adversarial network (GAN) by analyzing and blending information from lots of sample profiles to generate an alternate persona that would produce a profile that is indistinguishable from the sample profiles. Any one or more of the above techniques for generating alternate personas can be used independently or in combination by alternate persona generator module **62**.

(23) Alternate personas generated by alternate persona generator module **62** may only be stored locally on user device **30** in order to prevent the personas from potentially being reverse-engineered or linked to the real user profile. In other examples, user data agent **20** could store generated alternate personas in a secure database or other data storage to utilize the personas as options for users to select from when using user data agent **20**.

(24) Alternate persona generator module **62** can also include limitations built into the code to prevent certain types of alternate personas from being generated or selected. For example, alternate persona generator module **62** can have a pre-defined list of off-limits traits that cannot be selected or used for generating alternate personas. To some extent, such a list could be configurable by user **40**, e.g., to add additional restrictions. Additionally, there could be built in limitations on the number of alternate personas that alternate persona generator module **62** is permitted to generate and that user **40** can use in user data system **10**. These limitations and other similar limitations would prevent alternate persona generator module **62** from generating undesirable personas.

(25) Online activity module **64** is a third functional module of user data agent **20**. In some examples, online activity module **64** is a sequentially last functional module of user data agent **20**. Online activity module **64** can include methods in code for automatically performing online activities based the one or more alternate personas generated by alternate persona generator module **62**. The online activities carried out by online activity module **64** can be referred to as “false trail” activities. Online activity module **64** performs online activities on user device **30**, e.g., using browser **70** and/or user accounts **72**. Online activity module **64** surfs the web, uses applications, and/or performs other online activities on user device **30** as a user who embodies the one or more alternate personas would.

(26) In one example, online activity module **64** can automatically generate, remove, or modify/alter browser cookies using any existing cookie editing functionality of browser **70**. In some such examples, modifying cookies could more specifically include changing the information represented therein (e.g., “likes cookies” changed to “dislikes cookies”). Another example of cookie editing can include clearing and replacing all existing browser cookies periodically or based on pre-defined trigger events. That is, online activity module **64** can clear all existing browser cookies associated with user **40** on user device **30** and can replace them with browser cookies generated based on the traits of the alternate persona. In some examples, user data agent **20** can include functionality for storing sets of browser cookies (e.g., a set that corresponds to real user data **82** and a set that corresponds to artificial user data **84**) so that the sets can be alternately deployed via online activity module **64**. In this way, the alternate personas and online activity module **64** can be used to modify how user data **80** appears to profilers without fully obscuring real user data **82**. This can, in effect, give user **40** a more precisely tuned user experience when using online platforms.

(27) Because there may be very little standardization for what a specific cookie is or means between different websites, the cookie editing functionality of online activity module **64** can, in some examples, include many different methods for editing different types of cookies. Online activity module **64** can also include some form of automatic clicking to mimic a user selecting an item on a web page or within an application. Some online providers track click histories, so

automatic clicking can be used separately or to augment cookie editing functionality of online activity module **64**.

(28) In some examples, online activity module **64** can also perform online activities via user accounts **72**. Accordingly, online activity module **64** can include functionality for accessing and logging into user accounts **72**. In some examples, this functionality may require user **40** to configure permissions for user data agent **20**, such as for giving user data agent **20** access to a user credentials manager installed on user device **30**. In this way, user data agent **20** would not need to store any user credentials outside of user device **30**. By accessing user accounts **72**, online activity module **64** can perform several additional types of online activities. In one example, online activity module **64** can generate artificial search terms based on the traits of the alternate persona and input the artificial search terms into a search engine to generate artificial searches. As described previously, user accounts **72** can be online content service accounts for online content services (e.g., streaming services like YouTube, Netflix, Hulu, Spotify; social media like Facebook or Instagram; etc.). In some examples, online activity module **64** can select or interact with content from the online content services via corresponding ones of user accounts **72**. For example, if the content is a video or audio media resource, online activity module **64** can automatically play or subscribe to the video or audio media resource based on the traits of the alternate persona. If the content is an online survey, online activity module **64** can automatically complete and submit the online survey based on the traits of the alternate persona.

(29) Like alternate persona generator module **62**, online activity module **64** can include limitations built into the code to prevent certain types of online activities from being carried out on user device **30** or other misuses. For example, there can be limits on the total number of false trail activities that can be carried out by online activity module **64** in a defined period of time, such as an hour, a day, or other increments. Additionally, certain types of online activities may be actively prevented from occurring (or user data agent **20** may simply not include code for performing such activities). Online activities that might be prevented or highly limited (e.g., limited to simulating some steps without completing the activity) can including writing and sending fake emails, making fake purchases, or creating fake GPS locations. These limitations can be implemented so that the operation of user data system **10** is compatible with, e.g., the terms and conditions for using online platforms. Other limitations can include limiting when or for how long online activity module **64** can run and/or limiting access to some user accounts **72**. For example, online activity module **64** could include limitations in the code that only permit it to perform false trail activities on one account of each type, such as one Facebook account, one Netflix account, etc. As with limitations applicable to alternate persona generator module **60**, limitations applicable to online activity module **64** can also be configurable by user **40** in some cases or to some extent.

(30) User data **80** includes real user data **82** and artificial user data **84**. User data **80** can be generated by corresponding online activities using browser **70** and/or via user accounts **72** (which may or may not be accessed using browser **70**). Accordingly, user data **80** also represents data that can be collected by online providers. For example, user data **80** can include information stored in browser cookies, which can take numerous different forms, such as “click” history representing online content user **40** has interacted with previously, auto-fill information for forms (such as a birth date, addresses, phone numbers, etc.), and many others. User data **80** can also include search history from web searches conducted using browser **70** or click or search history generated within user accounts **72** for applications. More generally, user data **80** can include any type of data that is generated from online activities carried out on user device **30**.

(31) Real user data **82** represents portions of user data **80** that are generated by user **40** without intervention of user data agent **20**. That is, real user data **82** represents “real” online activity by user **40**. In contrast, artificial user data **84** represents portions of user data **80** that are generated within user data system **10** via user data agent **20**. That is, artificial user data **84** represents data that is generated via online activity module **64** based on the persona or personas selected from alternate

persona generator module **62**. In other words, artificial user data **84** does not necessarily represent “real” online activity by user **40**. The idea is that artificial user data **84** is indistinguishable from real user data **82** within user data **80** or that online providers will be unable to determine that artificial user data **84** is generated by user data agent **20** rather than user **40**. In some examples, artificial user data **84** overwhelms the representation of real user data **82** in a user profile thereafter created by an online provider such that the user profile will no longer be based on traits actually associated with user **40**. In other examples, artificial user data **84** can be used as a supplement to real user data **82** to introduce more nuance or distinction between different profiles created by online providers (e.g., as will be described with respect to FIG. 3).

(32) User data is often analyzed by profilers using algorithms that look for patterns in the user's behavior. User data system **10**, according to techniques of the present disclosure, allows a user to automatically obscure some of the patterns in their online behavior, making much of that data worthless to profilers. More specifically, user data **80** can become less valuable to profilers when it includes artificial user data **84** because advertising companies will not want to waste effort directing advertisements to an artificial persona. When the automatically generated user data becomes less valuable or even worthless to profilers, users are able to maintain both their privacy and a level of control over their real data.

(33) Traditional methods for preventing profilers from discerning patterns in online behavior include a user manually performing online activities they would not normally perform, such as clicking on links they would not normally click or using applications they would not normally use. This is at the very least time-consuming and is probably not destructive enough to the user's online profile to make their data useless. Another option would be to simply not use the internet, but that is a highly disruptive and restricting option that severely reduces the functionality of internet-based applications and other internet platforms and is not realistic for most users in the modern world. Other related techniques in the ballpark of improving user privacy online, such as using virtual private networks (VPNs) or The Onion Router (TOR), generally work to improve security of online communications for a user but do not obscure a user's real data.

(34) User data system **10** including user data agent **20** allows users to obscure their data without having to sacrifice total functionality of internet-based applications. Although user data system **10** to some extent prioritizes privacy over having highly personalized recommendations, operation of user data agent **20** overall has minimal impact to a user's online experience in that user **40** can continue using the full functionality of applications, etc., on user device **30** without concern that their user data will be misused or sold. Moreover, as described above with respect to the cookie editing functions of online activity module **64**, user data system **10** includes options for only partially or transiently obscuring real user data **82**. Once real user data **82** is obscured by artificial user data **84**, online providers can no longer target user **40** in ways that may be undesired.

(35) User data system **10** is also highly customizable for different users and their respective privacy or user data generation concerns because users **40** can modify or select traits for alternate persona generator module **62** to use for generating alternate personas. Moreover, artificial user data **84** is automatically generated through operation of online activity module **64**, and, thus, requires minimal effort by user **40** to modify the data that is available to profilers. User data system **10** also has the advantage that user data agent **20** does not need to be especially accurate in causing artificial user data **84** to be produced (e.g., artificial user data **84** does not need to be exactly opposite of real user data **82**) because obfuscation can be accomplished simply by bombarding online providers with junk data. In this way, user data system **10** can function effectively even with a relatively sparse user profile as a starting point.

(36) Two non-limiting implementations of alternate persona generator module **62** according to techniques of this disclosure will be described with reference to FIGS. 2-3. Several components of user data system **10** shown in FIG. 1 are omitted in FIGS. 2-3 for ease of discussion, but it should be understood that either of the implementations of alternate persona generator module **62** as

described with reference to FIGS. 2-3 can be used with user data system 10. Additionally, although depicted in FIGS. 2-3 as separate examples, a user data system according to techniques of this disclosure can include any combination of the following features.

(37) FIG. 2 is a schematic block diagram showing details of a first example of generating and using alternate personas 85 in user data system 10. FIG. 2 shows alternate persona generator module 62 (of user data system 10 shown in FIG. 1), browser 70, user accounts 72 (including user accounts 72A-72n), and artificial user data 84.

(38) Additional details of alternate persona generator module 62 are described above with reference to FIG. 1. As shown in FIG. 2, alternate persona generator module 62 generates personas 85A-85n. Personas 85A-85n can include any number of distinct personas 85. Personas 85 can include several candidate personas, and one or more of personas 85 can be selected to be applied to browser 70 and user accounts 72. In the example shown in FIG. 2, persona 85A is selected and applied to browser 70 and user accounts 72, whereas the remaining personas 85B-85n are rejected or unused. In other examples, any ones of personas 85A-85n can be applied to browser 70 and user accounts 72. In yet other examples, alternate persona generator module 62 may only generate one persona 85 and that persona will be applied to browser 70 and user accounts 72. Artificial user data 84 is produced from each of browser 70 and user accounts 72, e.g., via operation of online activity module 64 as shown in FIG. 1 using the selected ones of personas 85A-85n.

(39) As described above with respect to FIG. 1, user data system 10 including alternate persona generator module 62 allows for effective, customizable, and user-friendly data obfuscation of real user data 82 with artificial user data 84.

(40) Referring now to FIG. 3, FIG. 3 is a schematic block diagram showing details of a second example of generating and using alternate personas 85 in user data system 10. FIG. 3 shows alternate persona generator module 62 (of user data system 10 shown in FIG. 1), user account 72, artificial user data 84, and personas 85 (including personas 85A-85n). As illustrated in FIG. 3, user account 72 includes sub-accounts 90A-90n.

(41) Additional details of alternate persona generator module 62 are described above with reference to FIG. 1. As shown in FIG. 3, alternate persona generator module 62 generates personas 85A-85n. Personas 85A-85n can include any number of distinct personas 85. Rather than a single one of personas 85 being selected (e.g., as shown in FIG. 2), a number of personas 85 selected can match a number or subset of sub-accounts 90A-90n associated with user account 72. Each sub-account 90A-90n can be a subdivision of the overall user account 72 intended for multiple users to be able to separately access and use user account 72. In other examples, sub-accounts 90A-90n can be separate accounts for one user that are all accounts under one online platform (e.g., several email accounts for one user on one email service). In the example shown in FIG. 3, persona 85A is applied to sub-account 90A, persona 85B is applied to sub-account 90B, and persona 85n is applied to sub-account 90n. In other examples, any ones of personas 85A-85n can be applied any one or more of sub-accounts 90A-90n. Artificial user data 84 is produced from each of sub-accounts 90A-90n, e.g., via operation of online activity module 64 as shown in FIG. 1 using personas 85A-85n.

(42) Alternate persona generator module 62 as described with respect to FIG. 3 could be implemented with or without user profile generator module 60 (FIG. 1). In an implementation that includes user profile generator module 60, personas 85 can automatically be built with traits different from traits associated with a user profile for user 40 that was generated by user profile generator module 60. In an implementation that does not include user profile generator module 60, user 40 could simply identify and select traits or clusters for personas 85, and alternate persona generator module 62 could then generate personas 85 based on those selected traits, rather than generating personas 85 relative to a user profile generated by user profile generator module 60. For example, a user could select a first set of traits that the user desires to associate with sub-account 90A and a second set of traits that the user desires to associate with sub-account 90B, up to an nth set of traits that the user desires to associate with sub-account 90n. Alternate persona generator

module **62** can then generate corresponding personas **85A-85n** based on the respective first and second through nth sets of traits.

(43) Personas **85** can be used to produce artificial user data **84** that obscures any real user data **82** (not shown). Additionally, or alternatively, personas **85** can also be used to produce artificial user data **84** that is targeted to cause an online provider for user account **72** to generate different recommendations for each of sub-accounts **90A-90n** to which one of personas **85A-85n** is applied. That is, rather than obscuring data, the implementation of alternate persona generator module **62** shown in FIG. **3** can also utilize personas **85** to automatically tailor sub-accounts **90A-90n** for particular purposes or situations, depending on a user's preferences. Accordingly, artificial user data **84** can be used as a supplement to real user data **82** (not shown) to automatically introduce more nuance or distinction between different profiles that are subsequently created by online providers from ones of sub-accounts **90A-90n** (e.g., as compared to more generalized profiles associated with a single user).

(44) In one non-limiting example where user account **72** is a video streaming account, a first one of sub-accounts **90A-90n** (e.g., sub-account **90A**) could be designated for personal use by a user; another of sub-accounts **90A-90n** (e.g., sub-account **90B**) could be designated for family use; and another of sub-accounts **90A-90n** (e.g., sub-account **90n**) could be designated for movies only rather than television shows. A first set of traits could be identified that would be associated with personal use of sub-account **90A**, a second set of traits could be identified that would be associated with family use of sub-account **90B**, and a third set of traits could be identified that would be associated with movie-watching only use of sub-account **90n**. Alternate persona generator module **62** would then generate persona **85A** based on the first set of traits, persona **85B** based on the second set of traits, and persona **85n** based on the third set of traits, such that corresponding ones of personas **85A-85n** are generated based on traits that match the desired purpose for each of sub-accounts **90A-90n**. Accordingly, respective portions of artificial user data **84** generated from each of sub-accounts **90A-90n** will correspond to the traits of the one of personas **85A-85n** that was applied to the sub-account.

(45) In addition to the data obfuscation benefits described above with respect to FIGS. **1-2**, the implementation of alternate persona generator module **62** shown in FIG. **3** allows a user to automatically tailor sub-accounts **90A-90n** of an overall user account **72** based on the user's preferences. This provides automatic online user account management capabilities through a similar technique as described herein for intentionally obscuring real user data. More specifically, a user can automatically guide (or to some extent control) what types of recommendations they would like to receive at individual sub-accounts **90A-90n** by applying different personas **85** to each sub-account and allowing user data agent **20** to produce artificial user data **84** from each sub-account, such that artificial user data **84** is in turn used by the online provider associated with the overall user account **72** to generate recommendations. In this way, this implementation of alternate persona generator module **62** is both efficient and customizable for managing sub-accounts **90A-90n** of user account **72**.

(46) From the perspective of an online provider, the output of user data system **10** is similar in this implementation compared to the implementation described above with reference to FIG. **2**. The main difference is more perceptible from the user's perspective in that personas **85** are not selected to have traits that obscure real user data **82**, rather they are selected to have traits tailored to specific uses or preferences for ones of sub-accounts **90A-90n**. This enables a user to combat persistent recommendations from online providers that may not apply to or be desirable for all aspects of the user's online activities. It also enables a user to automatically use sub-accounts **90A-90n** to segment or further distinguish characteristics of their online activities, such as preferences that only apply under certain circumstances for the user.

(47) FIG. **4** is a flowchart illustrating steps **110-150** of process **100** for protecting user privacy online. Process **100** will be described with reference to components of user data system **10**

described above (FIGS. 1-3).

(48) As illustrated in FIG. 4, a first step of process **100** is to collect user data generated by user **40** on user device **30** (step **110**). The user data can be collected by user profile generator module **60**, which can monitor the online behavior of the user. For example, the user data collected in step **110** can include information stored in browser cookies. At step **120**, user profile generator module **60** identifies a first set of traits associated with the user data. The first set of traits can be further matched to one or more clusters or groups. At step **130**, user profile generator module **60** generates a user profile based on the first set of traits associated with the user data. The user profile can be similar to a user profile that would be created by an online provider or profiler in the course of a user's normal use of the internet. Each of steps **110-130** can be carried out by user profile generator module **60**.

(49) At step **140**, alternate persona generator module **62** generates an alternate persona (e.g., one of alternate personas **85**) that is defined by a second set of traits that is different from the first set of traits. Several techniques for generating the alternate persona are described above with reference to FIG. 1. For example, alternate persona generator module **62** can include machine learning techniques for intelligently generating the alternate persona.

(50) At step **150**, online activity module **64** automatically performs online activities based on the alternate persona generated in step **140**. The online activities performed by online activity module **64** produce artificial user data **84**, which can obscure real user data **82**. Step **150** can be a final step of process **100**. Although illustrated as single steps, it should be understood that each of steps **110-150** can be repeated any number of times in process **100**.

(51) Process **100**, including step **140** for generating an alternate persona and step **150** for automatically performing online activities based on the alternate persona, allows for effective, customizable, and user-friendly data obfuscation of real user data **82** with artificial user data **84**.

(52) FIG. 5 is a flowchart illustrating steps **210-250** of process **200** for tailoring online user sub-accounts. Process **200** will be described with reference to components of user data system **10** described above (FIGS. 1-3).

(53) As illustrated in FIG. 5, a first step of process **200** is accessing online user account **72** that includes sub-accounts **90A-90n** (step **210**). User account **72** can be an overall account associated with an online provider, such as an online content service. Each of sub-accounts **90A-90n** can be separate accounts within user account **72** that are designed to be used by different users or can be separate accounts for the same online content service. At step **220**, user **40** can identify traits associated with each of sub-accounts **90A-90n**, including a first set of traits associated with one of sub-accounts **90A-90n** and a second set of traits associated with a different one of sub-accounts **90A-90n**. The first set of traits can be different from the second set of traits. Moreover, the first set of traits can be identified based on preferences that user **40** has for how the first one of sub-accounts **90A-90n** is to be used, and the second set of traits can be identified based on preferences that user **40** has for how the second one of sub-accounts **90A-90n** is to be used. User **40** can select the first and second sets of traits from a collection of pre-defined traits available via user data agent **20**.

(54) At step **230**, alternate persona generator module **62** generates a first alternate persona **85A-85n** that is based on the first set of traits identified by user **40**. Similarly, at step **240**, alternate persona generator module **62** generates a second alternate persona **85A-85n** that is based on the second set of traits identified by user **40**. Several techniques for generating the alternate personas are described above with reference to FIG. 1. For example, alternate persona generator module **62** can include machine learning techniques for intelligently generating the alternate persona.

(55) At step **250**, online activity module **64** automatically performs online activities based on the first one of alternate personas **85A-85n** for the first one of sub-accounts **90A-90n** and based on the second one of alternate personas **85A-85n** for the second one of sub-accounts **90A-90n** to produce artificial user data **84** that tailors each of sub-accounts **90A-90n** according to user preferences.

Online activity module **64** can access each sub-account **90A-90n** separately to perform online activities thereon. Step **250** can be a final step of process **200**. Although illustrated as single steps, it should be understood that each of steps **210-250** can be repeated any number of times in process **200**.

(56) Process **200**, including steps **230-240** for generating first and second alternate personas and step **250** for automatically performing online activities based on the first and second alternate personas applied to the corresponding ones of sub-accounts **90A-90n**, allows for efficient and customizable tailoring of sub-accounts within an overall user account based on a user's preferences.

(57) While the invention has been described with reference to an exemplary embodiment(s), it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment(s) disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

Claims

1. A method of protecting user privacy online, the method comprising: collecting, via a computer-based user data agent, user data generated by a user on a user device; identifying a first set of traits associated with the user data; generating a user profile based on the first set of traits associated with the user data; generating an alternate persona defined by a second set of traits that is different from the first set of traits; and automatically performing online activities based on the alternate persona to produce artificial user data that obscures real user data.
2. The method of claim 1, wherein collecting the user data further includes analyzing browser cookies generated by the user.
3. The method of claim 1, wherein collecting the user data further includes obtaining information associated with the user from a user account.
4. The method of claim 1, wherein generating the alternate persona further includes: training a model with machine learning based on the user profile; and using a trained model to generate the alternate persona.
5. The method of claim 1, wherein generating the alternate persona further includes: training a model with machine learning using a set of sample user profiles; and using a trained model to generate the alternate persona.
6. The method of claim 1, wherein generating the alternate persona further includes: generating multiple candidate personas; and selecting the alternate persona from amongst the candidate personas.
7. The method of claim 1, wherein generating the alternate persona further includes: analyzing a set of sample user profiles; blending information from the set of sample user profiles; and generating the alternate persona based on blended information from the set of sample user profiles such that the alternate persona is indistinguishable from individual sample user profiles in the set of sample user profiles.
8. The method of claim 1, wherein automatically performing the online activities based on the alternate persona further includes automatically modifying browser cookies based on the alternate persona.
9. The method of claim 8, wherein automatically modifying the browser cookies further includes: first, storing a first set of browser cookies that represents the browser cookies; second, clearing the browser cookies from a browser on the user device; third, replacing the browser cookies with a second set of browser cookies that are based on the alternate persona; fourth, storing the second set of browser cookies; fifth, clearing the second set of browser cookies from the browser; sixth,

replacing the second set of browser cookies with the first set of browser cookies; and seventh, repeating the second through sixth steps.

10. The method of claim 1, wherein automatically performing the online activities based on the alternate persona further includes accessing a user account associated with the user.

11. The method of claim 10, wherein automatically performing the online activities based on the alternate persona further includes: generating, via the user account, artificial search terms based on the alternate persona; and inputting the artificial search terms into an online search engine to generate artificial searches.

12. The method of claim 10, wherein the user account is an online content service account, and wherein automatically performing the online activities based on the alternate persona further includes interacting with content from the online content service.

13. The method of claim 12, wherein the content is a video or audio media resource, and automatically performing the online activities based on the alternate persona further includes automatically playing or subscribing to the video or audio media resource; or wherein the content is an online survey, and automatically performing the online activities based on the alternate persona further includes automatically completing the online survey.

14. A system for protecting user privacy online, the system comprising: a user device; and a computer-based user data agent including: one or more processors; and computer-readable memory encoded with instructions that, when executed by the one or more processors, cause the computer-based user data agent to: collect user data generated by a user on the user device; identify a first set of traits associated with the user data; generate a user profile based on the first set of traits associated with the user data; generate an alternate persona defined by a second set of traits that is different from the first set of traits; and automatically perform online activities based on the alternate persona to produce artificial user data that obscures real user data.

15. The system of claim 14, wherein the instructions that, when executed by the one or more processors, cause the computer-based user data agent to collect the user data further cause the computer-based user data agent to monitor online behavior of the user on behalf of the user.

16. The system of claim 15, wherein the instructions that, when executed by the one or more processors, cause the computer-based user data agent to monitor the online behavior of the user further cause the computer-based user data agent to monitor browser cookies generated by the user.

17. The system of claim 14, wherein the instructions that, when executed by the one or more processors, cause the computer-based user data agent to collect the user data further cause the computer-based user data agent to obtain information associated with the user from a user account.

18. The system of claim 14, wherein the instructions that, when executed by the one or more processors, cause the computer-based user data agent to generate the alternate persona further cause the computer-based user data agent to: train a model with machine learning based on the user profile or using a set of sample user profiles; and use a trained model to generate the alternate persona.

19. The system of claim 14, wherein the instructions that, when executed by the one or more processors, cause the computer-based user data agent to generate the alternate persona further cause the computer-based user data agent to: generate multiple candidate personas; and select the alternate persona from amongst the candidate personas.

20. The system of claim 19, wherein the computer-based user data agent further includes a user interface; and wherein the user accesses the user interface to review the candidate personas and to set parameters for selecting the alternate persona.
