

influence function to a baseline bid value.

In some embodiments, user devices 120 may interact with web servers 112 and/or advertiser servers 124. Web servers 112 and/or advertiser servers 124 may also interact with optimization system 122. All such communication may be performed via electronic network 101. Electronic Network 101 may be, in some embodiments, the Internet, but may in other embodiments comprise any number and configuration of different types of networks, such as an intranet, a Local Area Network ("LAN"), a Wide-Area Network ("WAN"), a Metropolitan-Area Network ("MAN"), or the like. In some embodiments, web servers 112, advertiser servers 124, and/or optimization system 122 can be implemented by a single device or multiple devices.

In certain embodiments, web servers 112, user devices 120, optimization system 122, and advertiser servers 124 may each be an assembly of hardware, including a memory, a central processing unit ("CPU"), and a user interface. The memory may include any type of RAM or ROM used for storing, either permanently or temporarily, software modules or instructions for execution by the CPU. The memory may also include a tangibly-embodied non-transitory computer-readable storage medium, such as magnetic storage including floppy disk, hard disk, or magnetic tape; semiconductor storage such as solid state disk ("SSD") or flash memory; optical disc storage; or magneto-optical disc storage. The CPU may include one or more processors for processing data according to instructions stored in the memory. The functions of the processor may be provided by a single dedicated processor or by a plurality of processors. Moreover, the processor may include, without limitation, digital signal processor ("DSP") hardware, or any other hardware capable of executing instructions. An optional user interface may be included with any of web servers 112, user devices 120, optimization system 122, and advertiser servers 124, and may include any type or combination of input/output devices, such as a display monitor, keyboard, or mouse.

Advertiser servers 124 may include any entities having online advertisements (e.g., banner ads, pop-ups, textual ads, video ads, etc.) desired to be delivered to online users. For example, advertiser servers 124 may have created advertisements relating to products or services marketable to one or more online users. Advertiser servers 124 may be configured to serve advertisements across web servers 112, for example, based on actions by user devices 120, and based on input from optimization system 122. The advertisements may be selected according to a bidding process, whereby various advertisers compete for placement of advertisements by submission of bid prices. Advertiser servers 124 may also be configured to serve ads based on contextual targeting of websites, search results, and/or user profile information. Advertiser servers 124 may further generate behavioral logs, leadback logs, click logs, action logs, conversion logs, and/or impression logs, based on users' interactions with, for example, web servers 112, such as by interactions with websites and ads running on web servers 112.

Optimization system 122 or Advertiser server 124 may include a graphical user interface ("GUI") whereby an advertiser may configure advertising campaigns, or may specify campaign specific information. Moreover, an advertiser may use the GUI to specify descriptions corresponding to particular advertisements. The GUI may also provide information for an advertiser regarding overall revenue, estimates of ad impacts, and past, current, or future potential bidding costs.

FIG. 2 illustrates an exemplary computerized system 200, consistent with certain embodiments of the present disclosure. System 200 includes electronic network 201, web server 212, user device 220, and optimization system 222. User device 220 may communicate over network 201 with web server 212, to request a web page 213. The various components of system 200 may include an assembly of hardware, software, and/or firmware, including a memory, a CPU, and/or a user interface. Memory may include any type of RAM or ROM embodied in a physical storage medium, such as magnetic storage including floppy disk, hard disk, or magnetic tape; semiconductor storage such as SSD or flash memory; optical disc storage; or magneto-optical disc storage. A CPU may include one or more processors for processing data according to a set of programmable instructions or software stored in the memory. The functions of each processor may be provided by a single dedicated processor or by a plurality of processors. Moreover, processors may include, without limitation, DSP hardware, or any other hardware capable of executing software. An optional user interface may include any type or combination of input/output devices, such as a display monitor, keyboard, and/or mouse.

As shown in the exemplary embodiment of FIG. 2, web page 213 may contain a multitude of items

logs, demographic and interest data gathered through data sharing arrangements with partners, prior purchase data, and geographic and other user agent data. Recording a user's advertisement engagement, including clicks, video views, or mouse hovering actions over a particular area of an advertisement space. Recording a user's visits to an advertiser's website or particular sections of an advertiser's website. Counting the number of times a user was exposed to a particular advertisement in total, for the current month, for the current week, for the current day, for the current hour, or for the current session, as well as functional forms to capture effect of decay, persistence of repeatedly seeing ads through time, and through time series aggregation functions as well as potential transformation functions such as Fourier, Z, and wavelet. Capturing further granularity through contextual relevance of the medium where the advertisement was shown, and where in the medium the advertisement was shown (e.g. above or below the viewable portion of the browser window, top of the screen), and time of the advertisement exposure. Counting an exposure amount when an advertisement is treated as a member of one or more groups of related advertisements. For instance, a count of display banner exposures if an advertisement is part of a particular display banner. Counting various forms of engaging with the advertisement, such as clicking on a display banner and viewing a video or calling the advertiser, as well as indirect forms such as immediately searching for information related to the advertisement, such as brand, product name, or product reviews, or immediately navigating to the advertiser's website or other content related to the advertisement following exposure.

In certain embodiments, advertisers, publishers, and/or ad network facilitators may assign a web cookie and/or unique user ID to each computer or Internet-enabled device identified as visiting a site in the ad network, enabling capturing of the user event data for purposes of creating a central feature set. In one embodiment, cookies may allow tracking of a user across websites in the ad network by identification of the assigned user ID, and may enable each transaction associated with the assigned user ID to be logged with an associated timestamp. For example, cookies stored locally on a user's computer may be accessed to identify the user and to determine the last time that the user viewed the advertisement and/or a web page. In addition, in instances when a cookie is unavailable, a virtual cookie may be used. A virtual cookie may be derived from available information such as the user's IP address, browser type, geographic location, connection speed, or any other accessible and appropriate session level data. In certain embodiments, data may be obtained for each user, which represents the user's tendency to return to a specific web site in a given period of time. This data may be initially generated using estimated figures based on known user attributes. The estimated figures may be modified over time using user viewing logs. User viewing logs may be created by storing the viewing patterns of a user over an extended period of time.

The user event data may be stored in a central location, for example, at advertising server 224. Based on the stored user event data, additional web content may be fetched by advertising server 224, and contextual tags associated with a URL where a transaction occurred may be incorporated into user event data. The user event data may then be analyzed, and for a particular product in interest, relevant feature sets may be extracted by determining the various users who have purchased the particular product.

According to the identified feature sets for the users, an advertiser may then attempt to determine how an advertisement may potentially influence the future purchasing by the user. However, the functional form of the likelihood distribution that governs future sales for a user is generally not known, and representations of a certain input state and a corresponding output optimal value may not be available. A parametric model may therefore be developed for this distribution based on the analysis of data involving past purchasing decisions, as well as data representing the various features of users, such that the appropriate ad influence can be calculated as set forth above. In certain embodiments, a single model may be created for all users based on the data, where the users are differentiated in the model based on the given state and the features of the users. However, it will be appreciated that this is not restricted to a single model, and in certain embodiments a model can be estimated for each user. The model can then provide a distribution for a user based on the known attributes or features of the user.

For example, an optimal value function can be considered for providing a suitable distribution given this situation. Let V^* denote the optimal value function, $r_{.sub.t}$ the reward, $\omega_{.sub.t}$ the advertisement, $c_{.sub.t}$ the cost of showing the advertisement, d the one period discount factor, and $S_{.sub.t}$ the state of information, all at time t . Dynamic programming can be applied, where the optimal value may be calculated by starting at the end and then recursively going backwards one period at a time until present time is reached. As such, in this embodiment, the value equation as follows: $V^*(S_{.sub.t}) = \max_{\omega_{.sub.t}} [r_{.sub.t}(\omega_{.sub.t}) - c_{.sub.t}(\omega_{.sub.t}) + dV^*(S_{.sub.t})]$

