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Raina

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(54) **DATA SEGMENTATION USING MACHINE LEARNING**

(71) Applicant: **WARPSPEED, Inc**, Pleasanton, CA (US)

(72) Inventor: **Abnesh Raina**, Pleasanton, CA (US)

(73) Assignee: **WARPSPEED, Inc.**, Pleasanton, CA (US)

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(22) Filed: **Apr. 9, 2021**

(51) **Int. Cl.**

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G06K 9/62	(2006.01)
G06N 20/00	(2019.01)
G06N 7/00	(2006.01)

(52) **U.S. Cl.**
CPC ***G06K 9/6261*** (2013.01); ***G06K 9/622*** (2013.01); ***G06K 9/623*** (2013.01); ***G06N 7/005*** (2013.01); ***G06N 20/00*** (2019.01)

(58) **Field of Classification Search**
CPC G06K 9/38; G06K 9/4652; G06K 9/6261; G06K 9/622; G06T 5/40; G06T 7/0081; G06T 7/0083; G06T 7/408; G06T 2207/20148; G06T 2207/20144; G06T 2207/10016; G06T 2207/10024; H04N 1/403; G06F 17/30243
See application file for complete search history.

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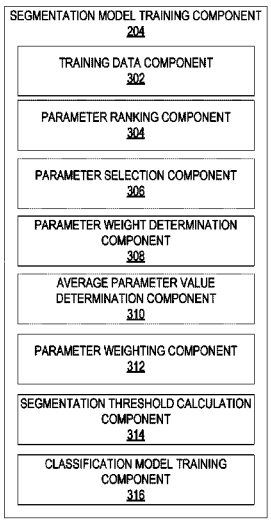
Primary Examiner — Amir Alavi

(74) *Attorney, Agent, or Firm* — Schwegman Lundberg & Woessner, P.A.

(57) **ABSTRACT**

Disclosed are systems, methods, and non-transitory computer-readable media for data segmentation using machine learning. A data segmentation system prioritizes parameters used for segmenting data into predetermined categories. For example, the data segmentation system uses linear regression to determine signal strength values for the individual parameters. The signal strength values can be used to automatically select a set of parameters for segmenting data, determine weights for the parameters and/or determine threshold segmentation values.

17 Claims, 18 Drawing Sheets



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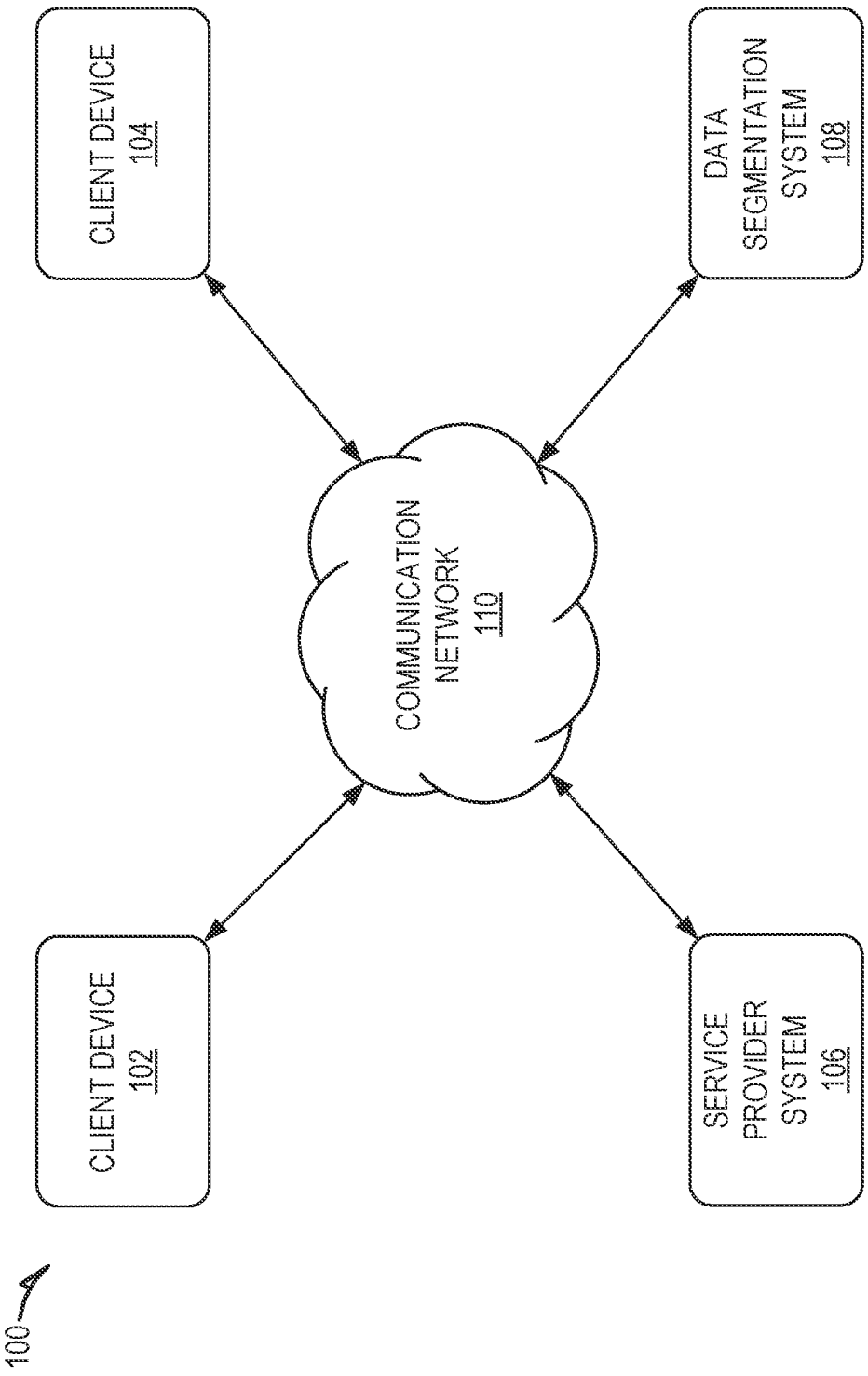

CLIENT DEVICE 104
DATA SEGMENTATION SYSTEM 108
COMMUNICATION NETWORK 110
CLIENT DEVICE 102
SERVICE PROVIDER SYSTEM 106
100

FIG. 1

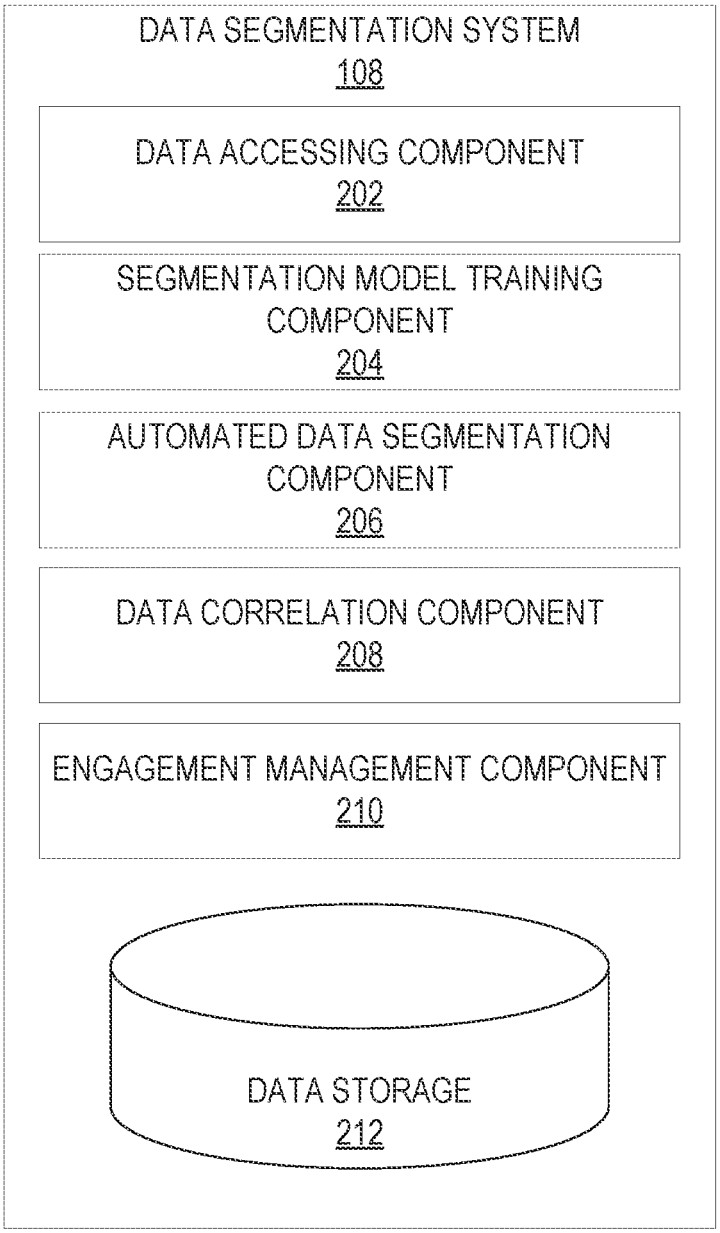

DATA SEGMENTATION SYSTEM
108
DATA ACCESSING COMPONENT
202
SEGMENTATION MODEL TRAINING COMPONENT
204
AUTOMATED DATA SEGMENTATION COMPONENT
206
DATA CORRELATION COMPONENT
208
ENGAGEMENT MANAGEMENT COMPONENT
210
DATA STORAGE
212

FIG. 2

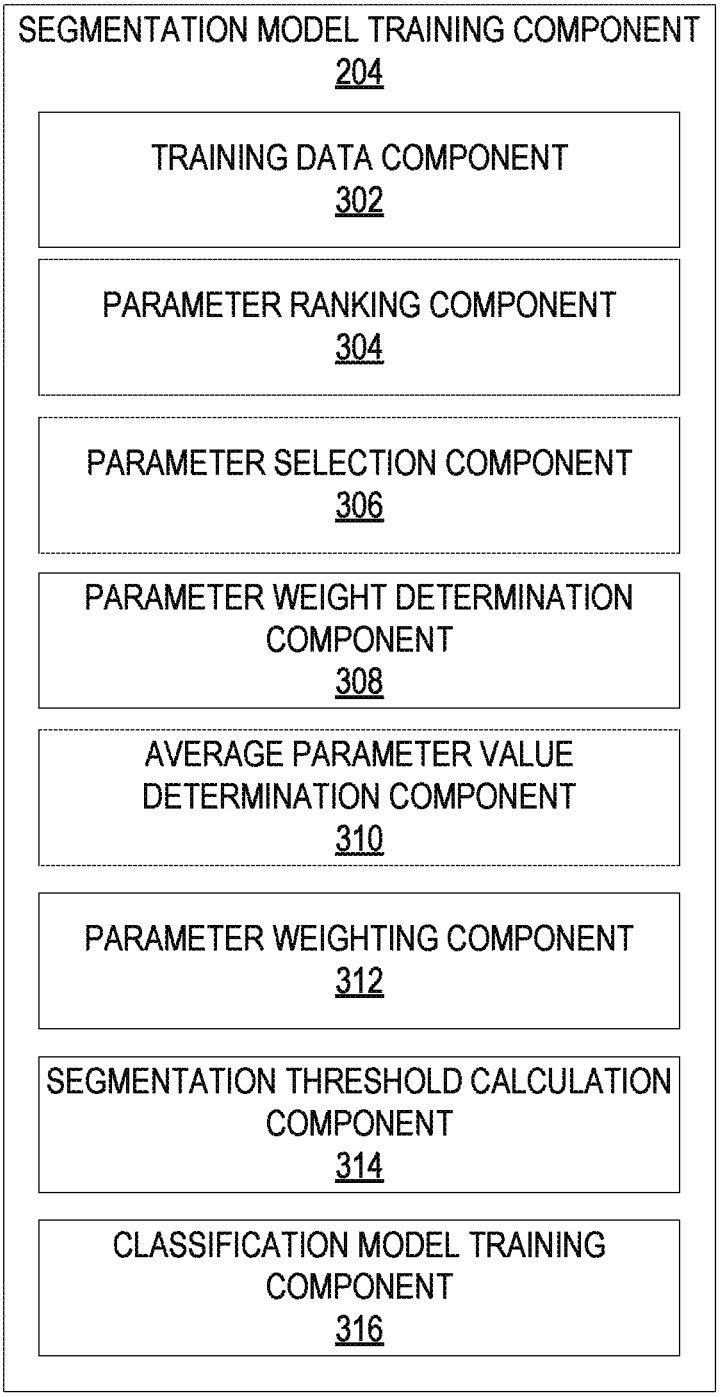

SEGMENTATION MODEL TRAINING COMPONENT
204
TRAINING DATA COMPONENT
302
PARAMETER RANKING COMPONENT
304
PARAMETER SELECTION COMPONENT
306
PARAMETER WEIGHT DETERMINATION COMPONENT
308
AVERAGE PARAMETER VALUE DETERMINATION COMPONENT
310
PARAMETER WEIGHTING COMPONENT
312
SEGMENTATION THRESHOLD CALCULATION COMPONENT
314
CLASSIFICATION MODEL TRAINING COMPONENT
316

FIG. 3

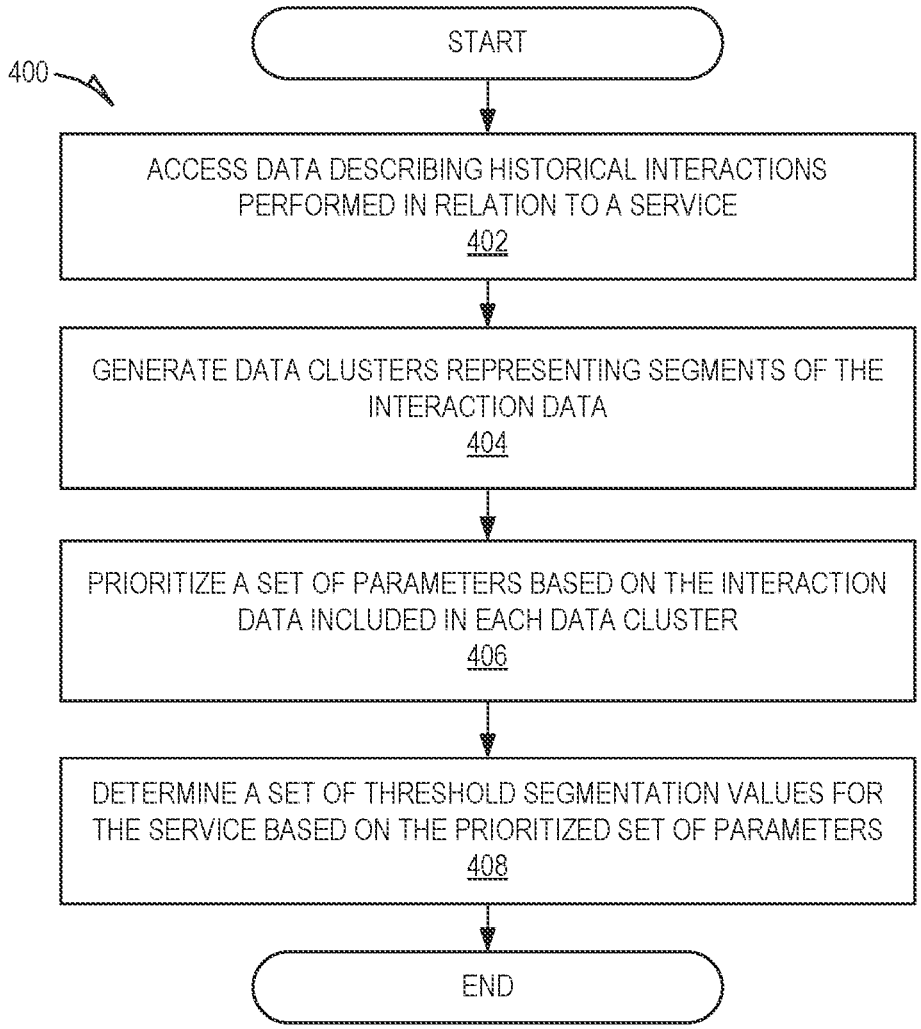

400
START
ACCESS DATA DESCRIBING HISTORICAL INTERACTIONS PERFORMED IN RELATION TO A SERVICE
402
GENERATE DATA CLUSTERS REPRESENTING SEGMENTS OF THE INTERACTION DATA
404
PRIORITIZE A SET OF PARAMETERS BASED ON THE INTERACTION DATA INCLUDED IN EACH DATA CLUSTER
406
DETERMINE A SET OF THRESHOLD SEGMENTATION VALUES FOR THE SERVICE BASED ON THE PRIORITIZED SET OF PARAMETERS
408
END

FIG. 4

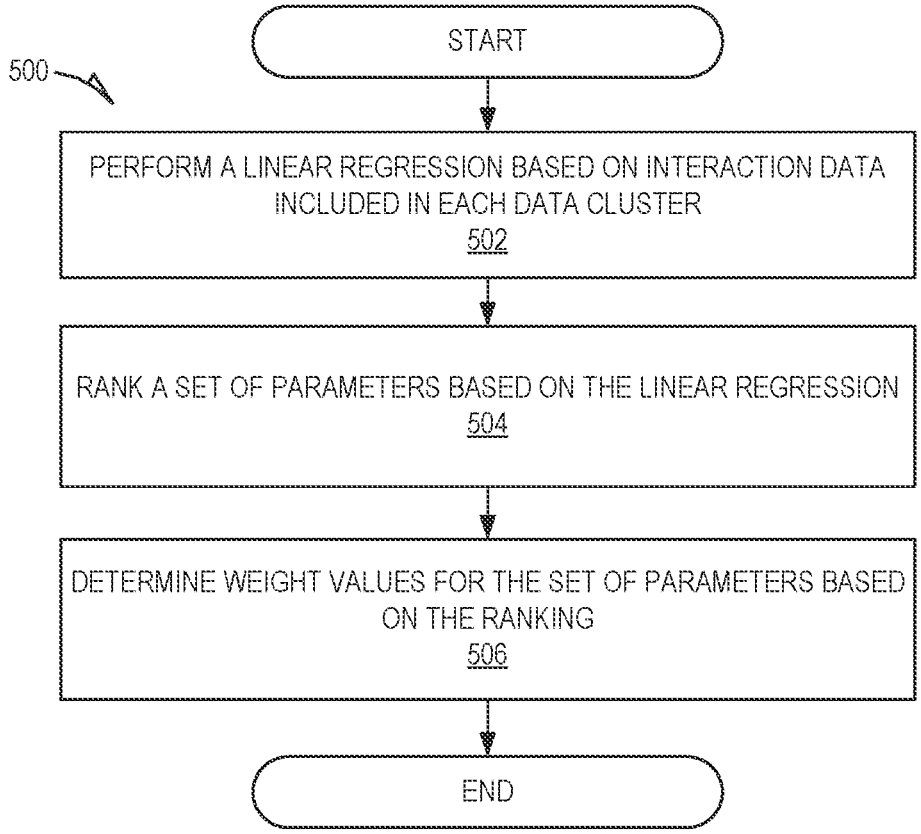

500
START
PERFORM A LINEAR REGRESSION BASED ON INTERACTION DATA INCLUDED IN EACH DATA CLUSTER
502
RANK A SET OF PARAMETERS BASED ON THE LINEAR REGRESSION
504
DETERMINE WEIGHT VALUES FOR THE SET OF PARAMETERS BASED ON THE RANKING
506
END

FIG. 5

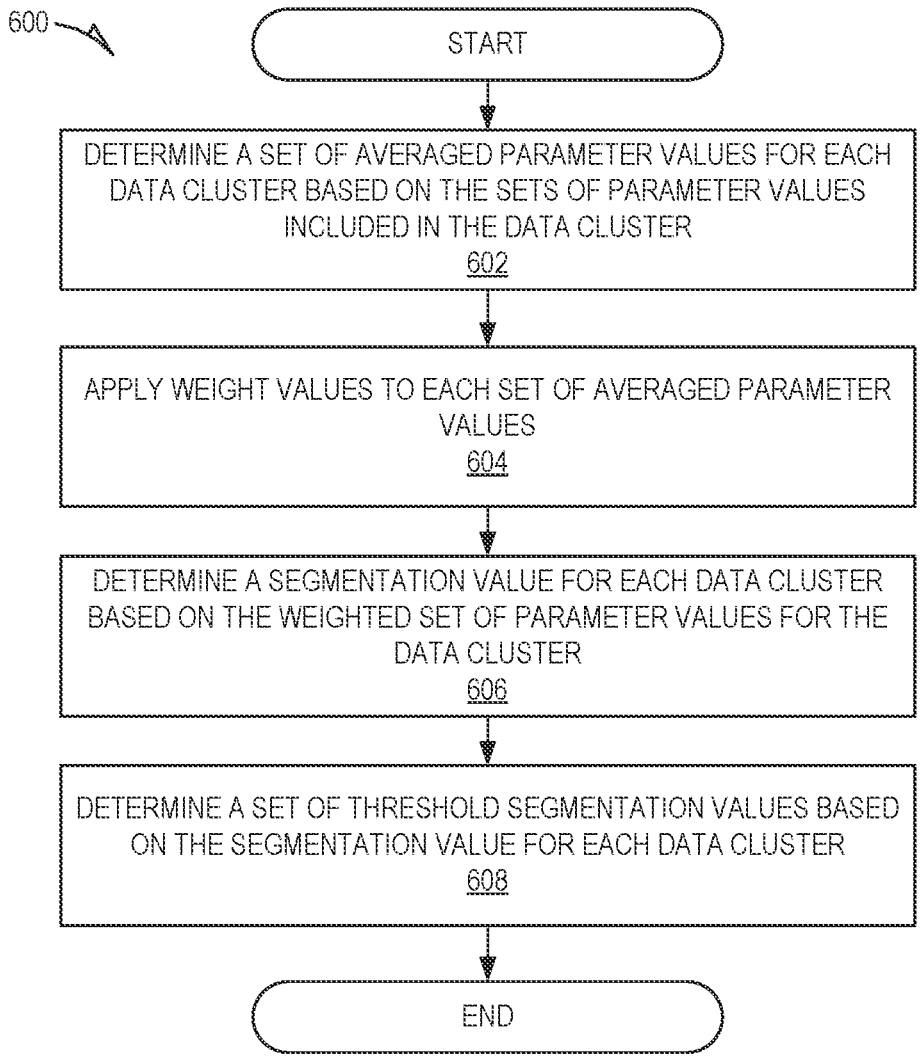

600
START
DETERMINE A SET OF AVERAGED PARAMETER VALUES FOR EACH DATA CLUSTER BASED ON THE SETS OF PARAMETER VALUES INCLUDED IN THE DATA CLUSTER
602
APPLY WEIGHT VALUES TO EACH SET OF AVERAGED PARAMETER VALUES
604
DETERMINE A SEGMENTATION VALUE FOR EACH DATA CLUSTER BASED ON THE WEIGHTED SET OF PARAMETER VALUES FOR THE DATA CLUSTER
606
DETERMINE A SET OF THRESHOLD SEGMENTATION VALUES BASED ON THE SEGMENTATION VALUE FOR EACH DATA CLUSTER
608
END

FIG. 6

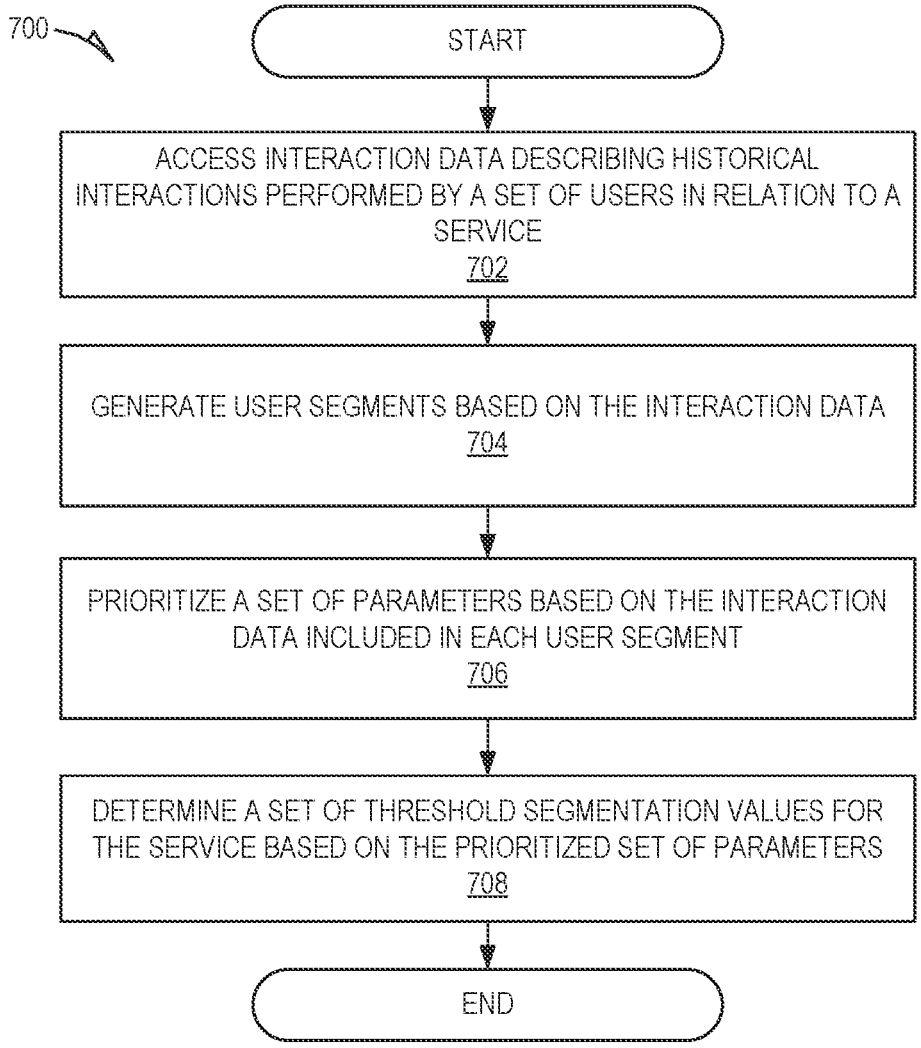

700
START
ACCESS INTERACTION DATA DESCRIBING HISTORICAL INTERACTIONS PERFORMED BY A SET OF USERS IN RELATION TO A SERVICE
702
GENERATE USER SEGMENTS BASED ON THE INTERACTION DATA
704
PRIORITIZE A SET OF PARAMETERS BASED ON THE INTERACTION DATA INCLUDED IN EACH USER SEGMENT
706
DETERMINE A SET OF THRESHOLD SEGMENTATION VALUES FOR THE SERVICE BASED ON THE PRIORITIZED SET OF PARAMETERS
708
END

FIG. 7

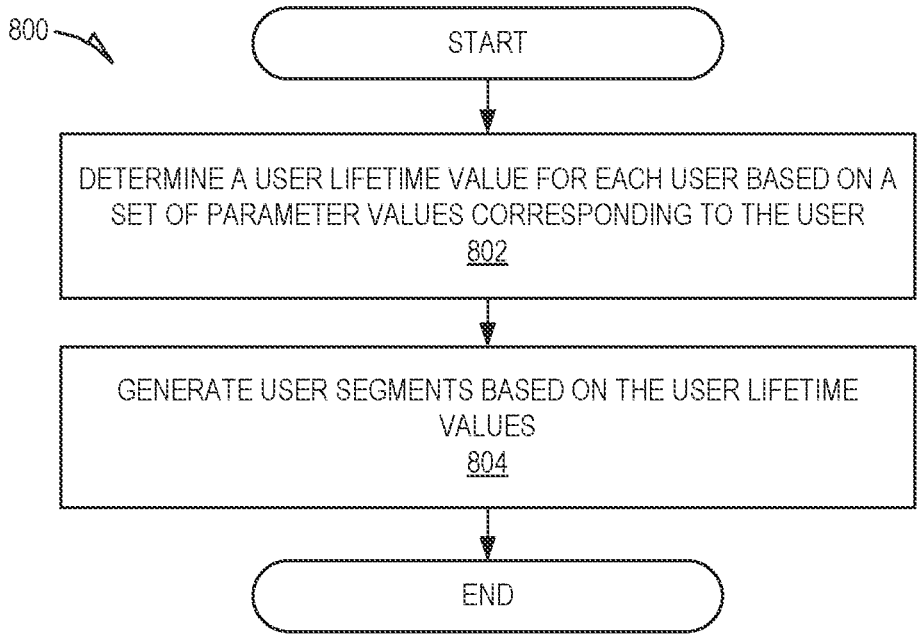

800
START
DETERMINE A USER LIFETIME VALUE FOR EACH USER BASED ON A SET OF PARAMETER VALUES CORRESPONDING TO THE USER
802
GENERATE USER SEGMENTS BASED ON THE USER LIFETIME VALUES
804
END

FIG. 8

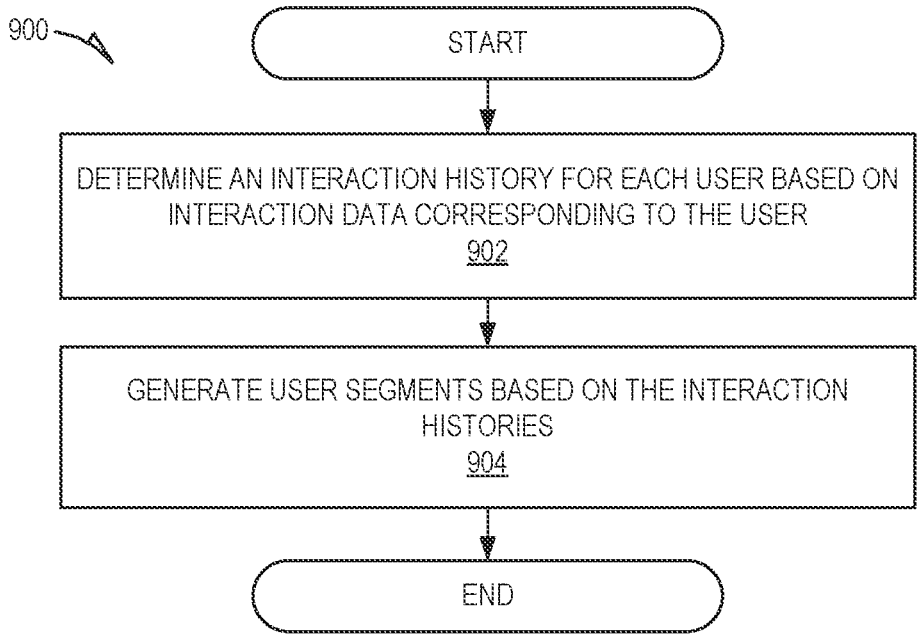

900
START
DETERMINE AN INTERACTION HISTORY FOR EACH USER BASED ON INTERACTION DATA CORRESPONDING TO THE USER
902
GENERATE USER SEGMENTS BASED ON THE INTERACTION HISTORIES
904
END

FIG. 9

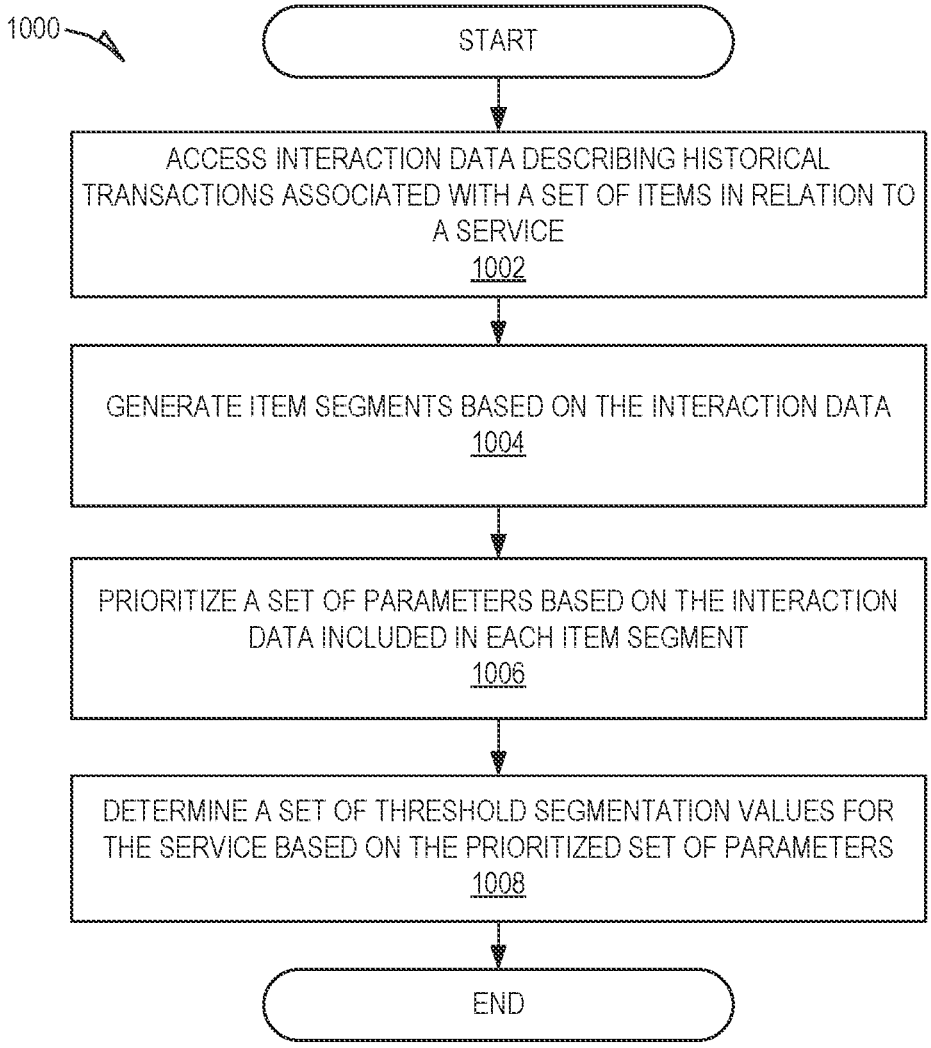

1000
START
ACCESS INTERACTION DATA DESCRIBING HISTORICAL TRANSACTIONS ASSOCIATED WITH A SET OF ITEMS IN RELATION TO A SERVICE
1002
GENERATE ITEM SEGMENTS BASED ON THE INTERACTION DATA
1004
PRIORITIZE A SET OF PARAMETERS BASED ON THE INTERACTION DATA INCLUDED IN EACH ITEM SEGMENT
1006
DETERMINE A SET OF THRESHOLD SEGMENTATION VALUES FOR THE SERVICE BASED ON THE PRIORITIZED SET OF PARAMETERS
1008
END

FIG. 10

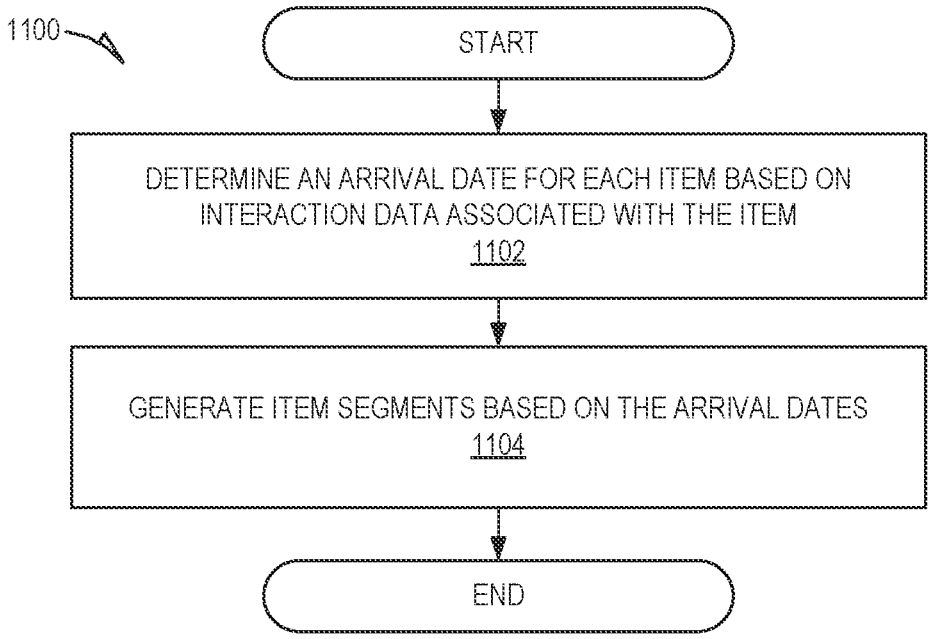

1100
START
DETERMINE AN ARRIVAL DATE FOR EACH ITEM BASED ON INTERACTION DATA ASSOCIATED WITH THE ITEM
1102
GENERATE ITEM SEGMENTS BASED ON THE ARRIVAL DATES
1104
END

FIG. 11

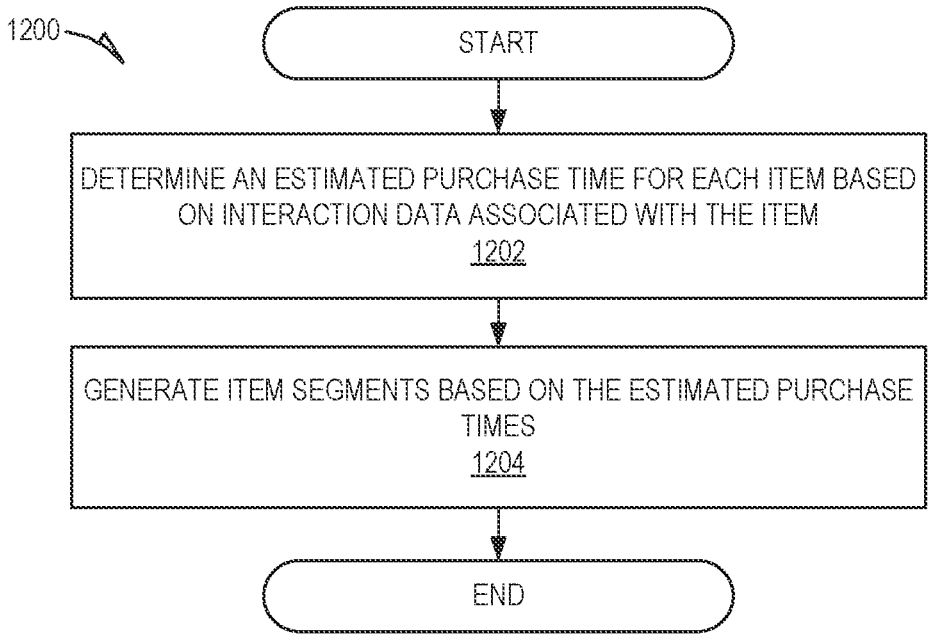

1200
START
DETERMINE AN ESTIMATED PURCHASE TIME FOR EACH ITEM BASED ON INTERACTION DATA ASSOCIATED WITH THE ITEM
1202
GENERATE ITEM SEGMENTS BASED ON THE ESTIMATED PURCHASE TIMES
1204
END

FIG. 12

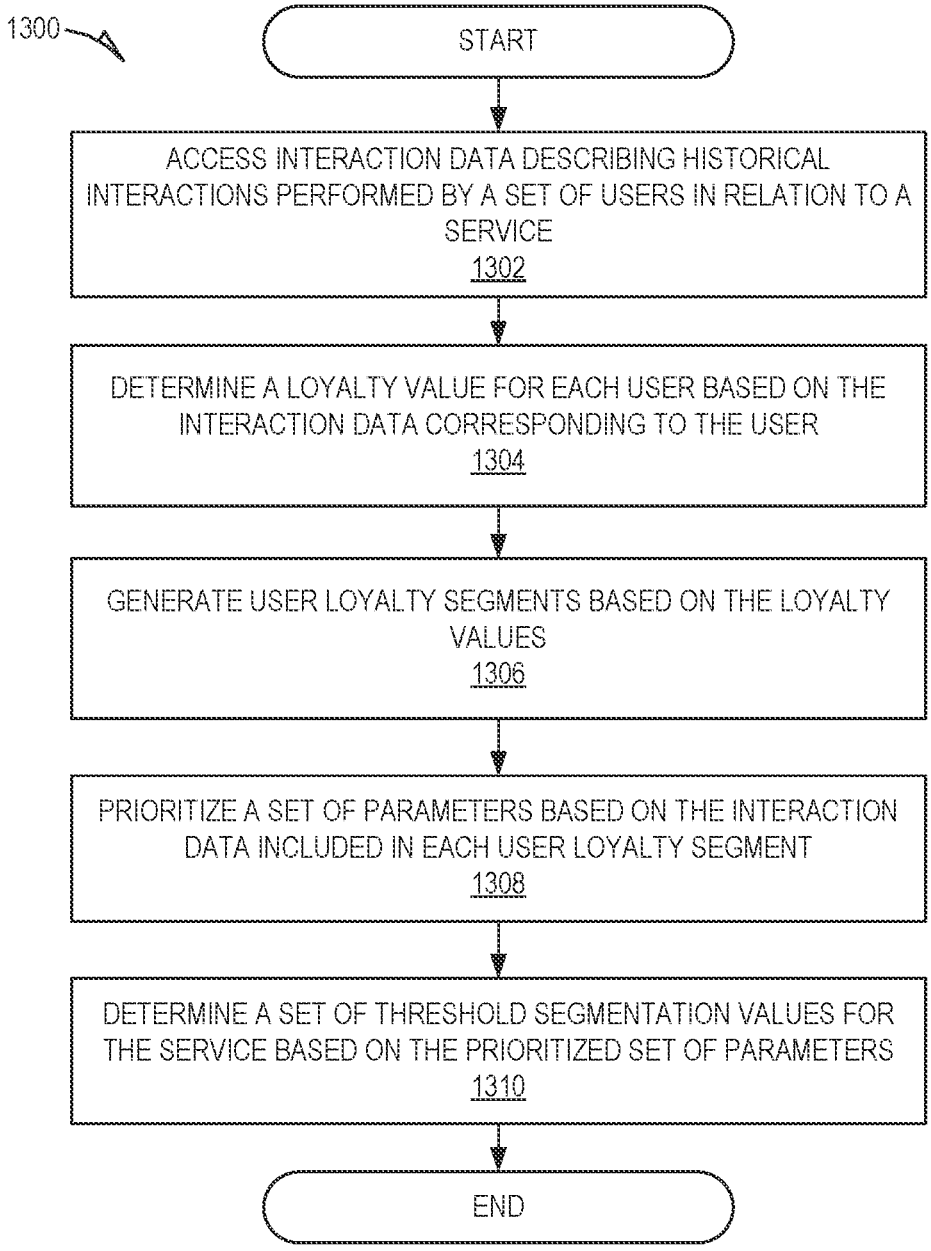

1300
START
ACCESS INTERACTION DATA DESCRIBING HISTORICAL INTERACTIONS PERFORMED BY A SET OF USERS IN RELATION TO A SERVICE
1302
DETERMINE A LOYALTY VALUE FOR EACH USER BASED ON THE INTERACTION DATA CORRESPONDING TO THE USER
1304
GENERATE USER LOYALTY SEGMENTS BASED ON THE LOYALTY VALUES
1306
PRIORITIZE A SET OF PARAMETERS BASED ON THE INTERACTION DATA INCLUDED IN EACH USER LOYALTY SEGMENT
1308
DETERMINE A SET OF THRESHOLD SEGMENTATION VALUES FOR THE SERVICE BASED ON THE PRIORITIZED SET OF PARAMETERS
1310
END

FIG. 13

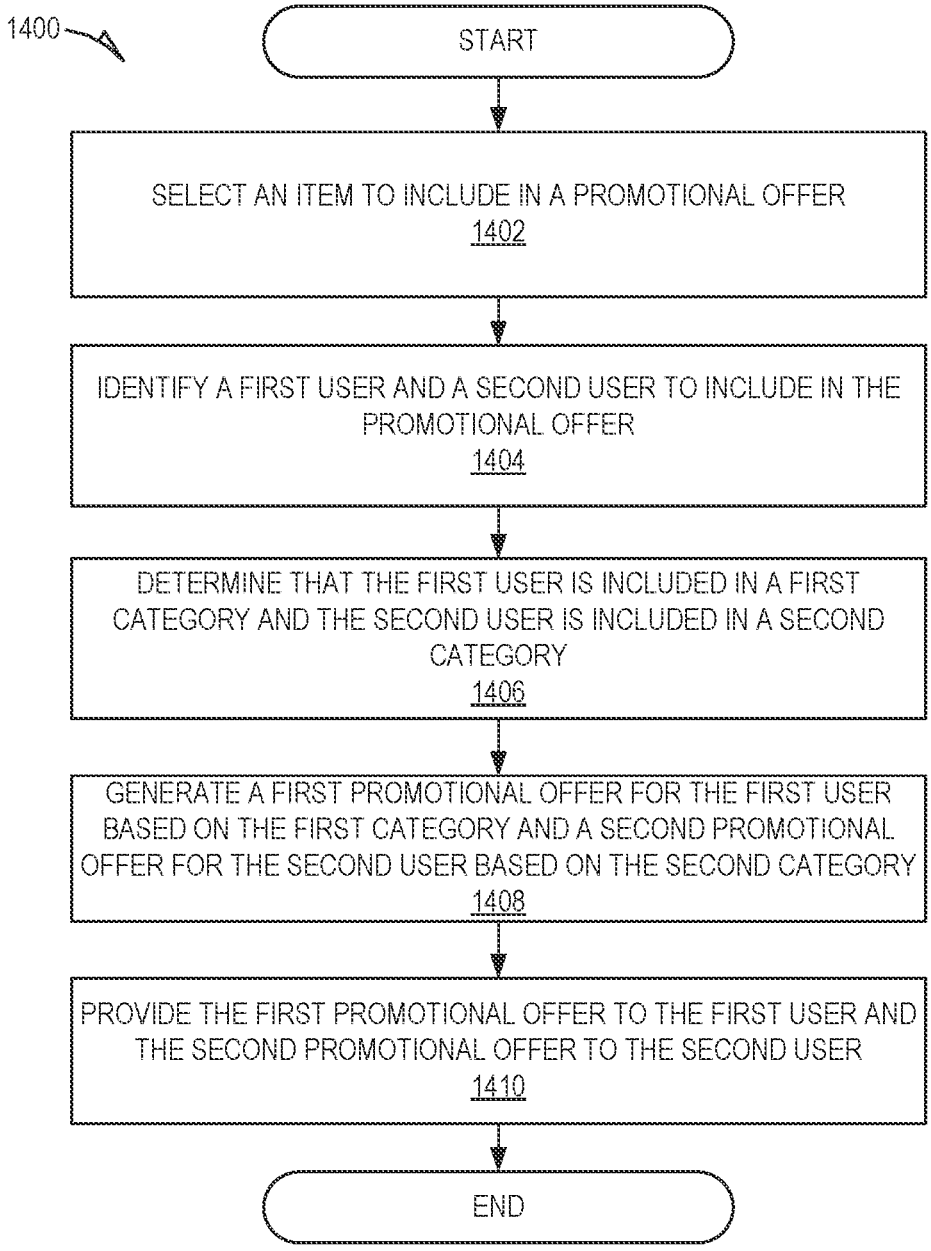

1400
START
SELECT AN ITEM TO INCLUDE IN A PROMOTIONAL OFFER
1402
IDENTIFY A FIRST USER AND A SECOND USER TO INCLUDE IN THE PROMOTIONAL OFFER
1404
DETERMINE THAT THE FIRST USER IS INCLUDED IN A FIRST CATEGORY AND THE SECOND USER IS INCLUDED IN A SECOND CATEGORY
1406
GENERATE A FIRST PROMOTIONAL OFFER FOR THE FIRST USER BASED ON THE FIRST CATEGORY AND A SECOND PROMOTIONAL OFFER FOR THE SECOND USER BASED ON THE SECOND CATEGORY
1408
PROVIDE THE FIRST PROMOTIONAL OFFER TO THE FIRST USER AND THE SECOND PROMOTIONAL OFFER TO THE SECOND USER
1410
END

FIG. 14

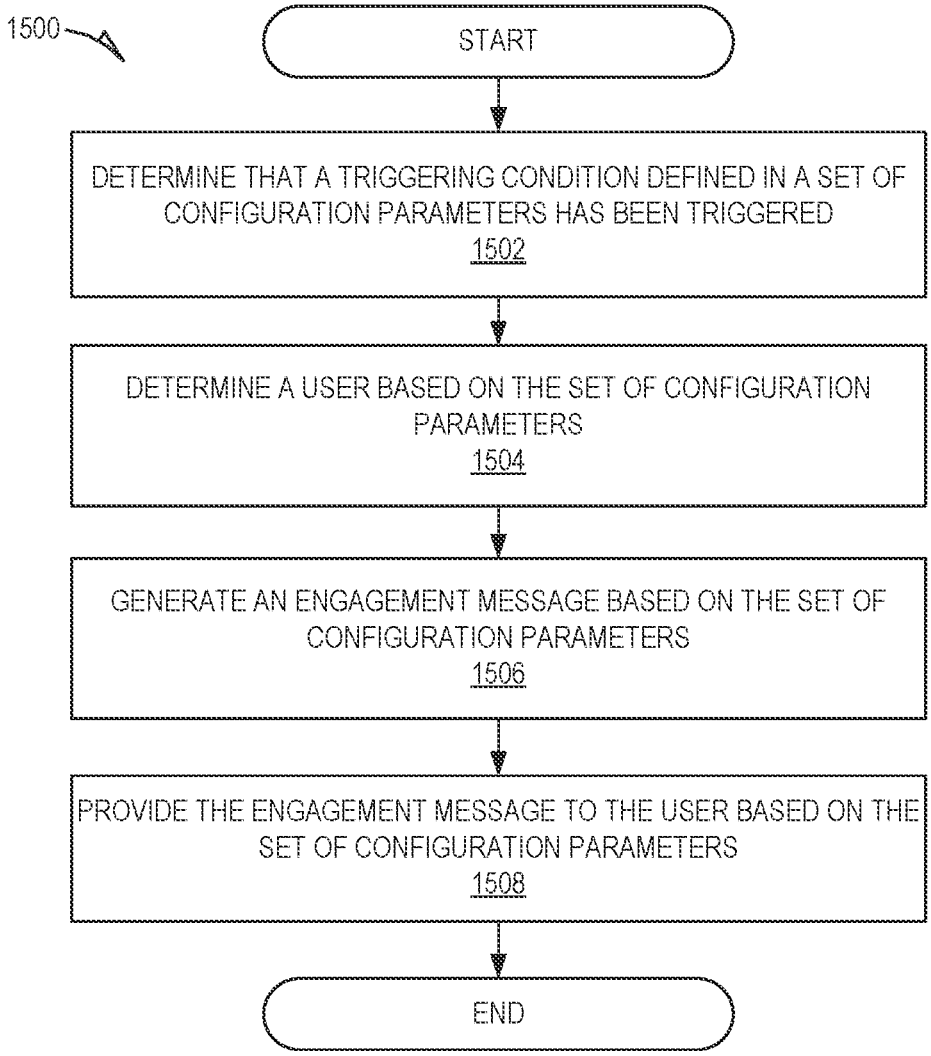

1500
START
DETERMINE THAT A TRIGGERING CONDITION DEFINED IN A SET OF CONFIGURATION PARAMETERS HAS BEEN TRIGGERED
1502
DETERMINE A USER BASED ON THE SET OF CONFIGURATION PARAMETERS
1504
GENERATE AN ENGAGEMENT MESSAGE BASED ON THE SET OF CONFIGURATION PARAMETERS
1506
PROVIDE THE ENGAGEMENT MESSAGE TO THE USER BASED ON THE SET OF CONFIGURATION PARAMETERS
1508
END

FIG. 15

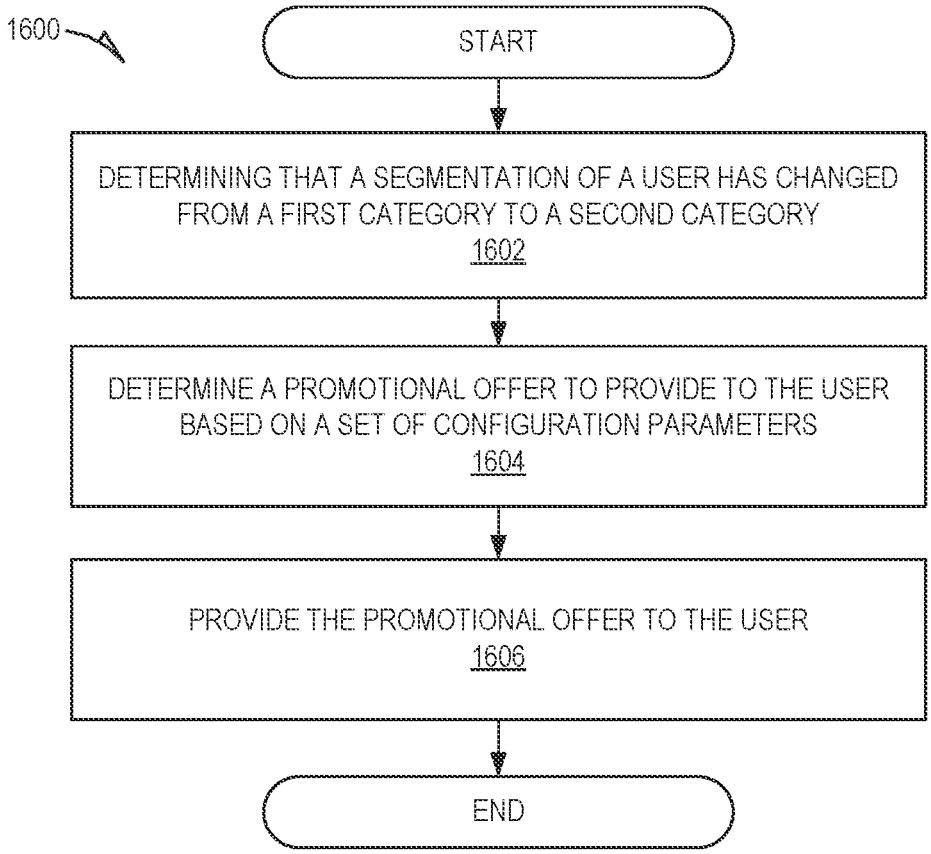
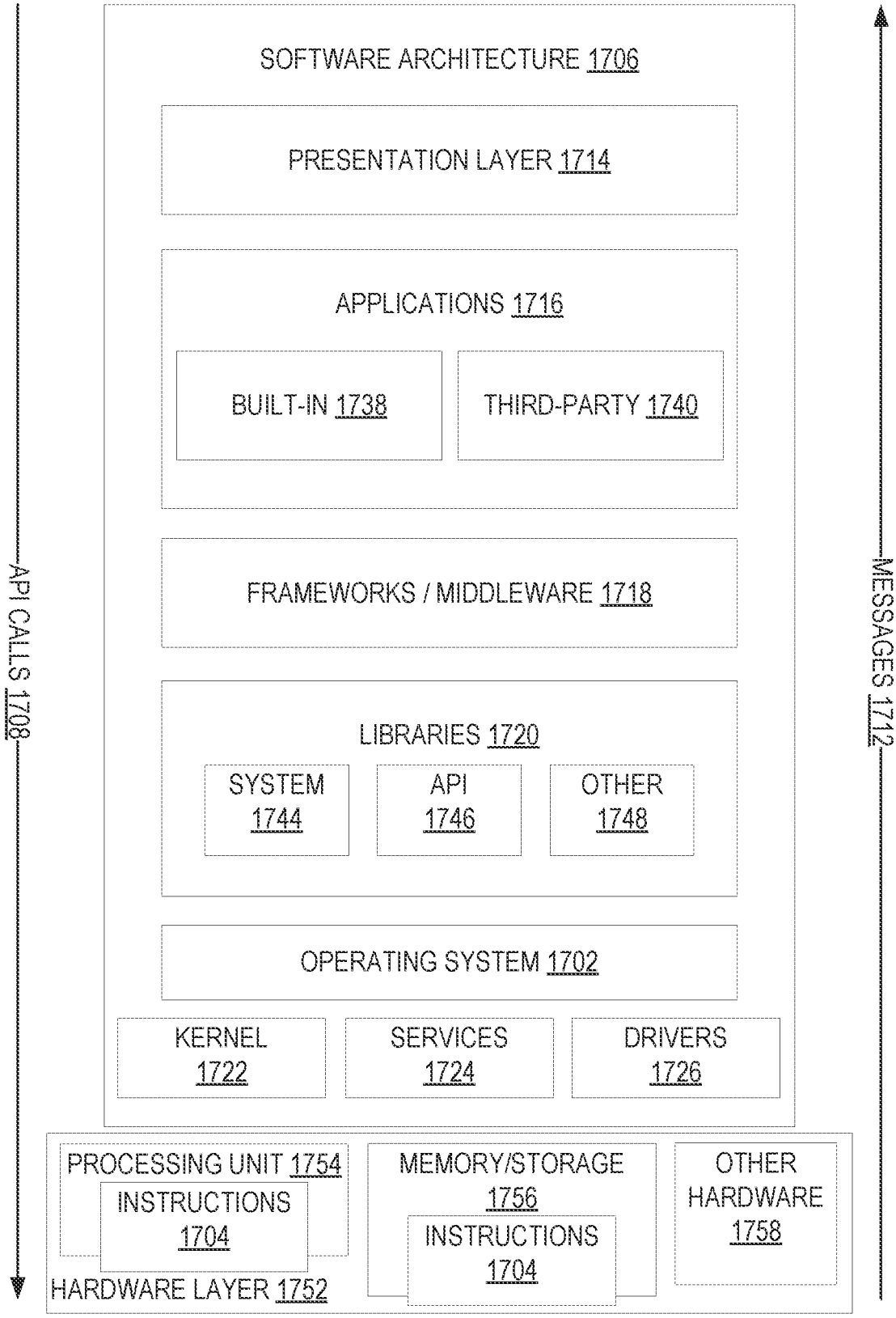

1600
START
DETERMINING THAT A SEGMENTATION OF A USER HAS CHANGED FROM A FIRST CATEGORY TO A SECOND CATEGORY
1602
DETERMINE A PROMOTIONAL OFFER TO PROVIDE TO THE USER BASED ON A SET OF CONFIGURATION PARAMETERS
1604
PROVIDE THE PROMOTIONAL OFFER TO THE USER
1606
END

FIG. 16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PRESENTATION LAYER 1714
APPLICATIONS 1716
BUILT-IN 1738
THIRD-PARTY 1740
FRAMEWORKS / MIDDLEWARE 1718
LIBRARIES 1720
SYSTEM 1744
API 1746
OTHER 1748
OPERATING SYSTEM 1702
KERNEL 1722
SERVICES 1724
DRIVERS 1726
PROCESSING UNIT 1754
INSTRUCTIONS 1704
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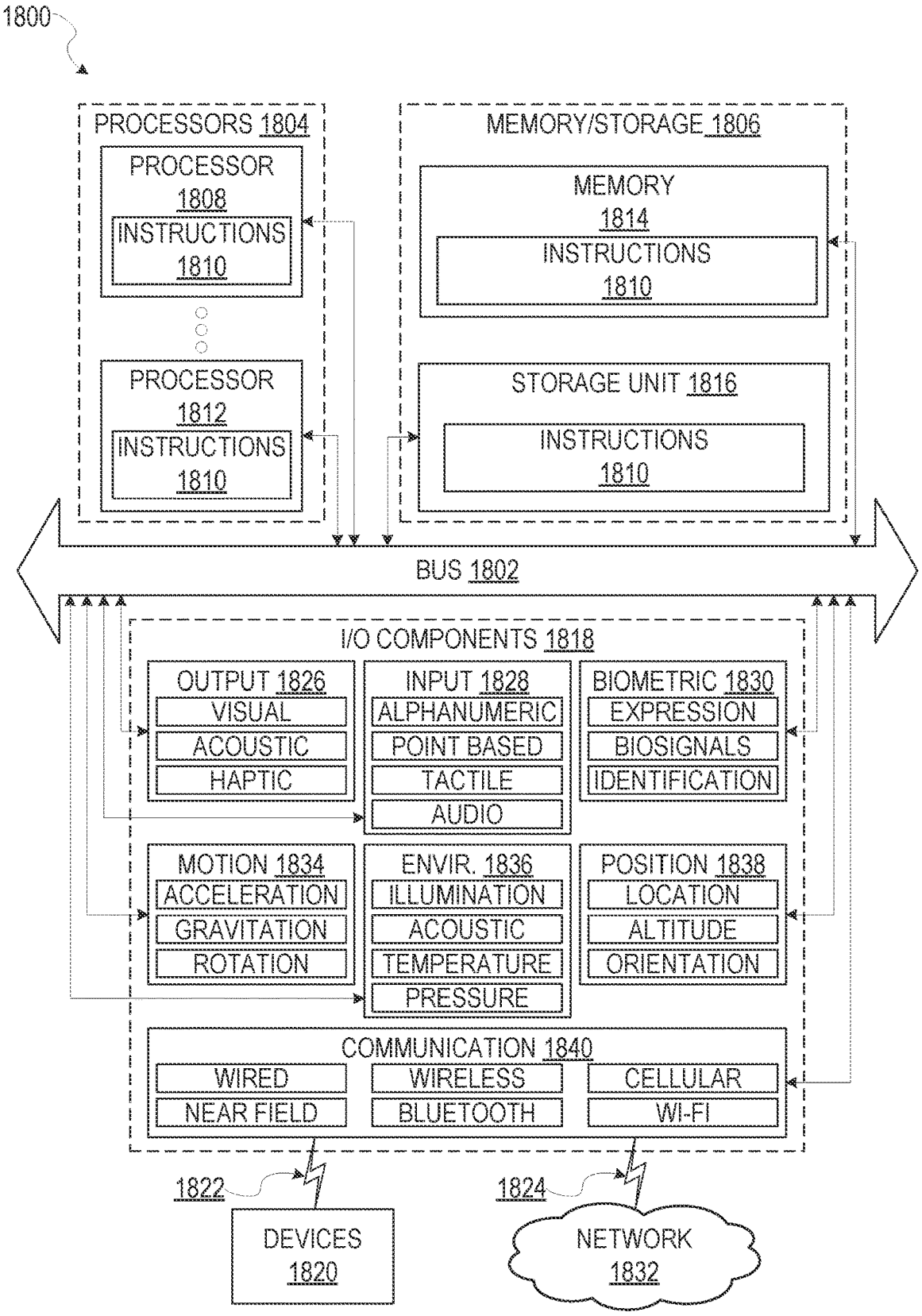
API CALLS 1708
MESSAGES 1712

FIG. 17


1800
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PROCESSOR 1808
INSTRUCTIONS 1810
PROCESSOR 1812
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MEMORY 1814
INSTRUCTIONS 1810
STORAGE UNIT 1816
INSTRUCTIONS 1810
BUS 1802
I/O COMPONENTS 1818
OUTPUT 1826
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HAPTIC
INPUT 1828
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POINT BASED
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AUDIO
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IDENTIFICATION
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ACCELERATION
GRAVITATION
ROTATION
ENVIR. 1836
ILLUMINATION
ACOUSTIC
TEMPERATURE
PRESSURE
POSITION 1838
LOCATION
ALTITUDE
ORIENTATION
COMMUNICATION 1840
WIRED
NEAR FIELD
WIRELESS
BLUETOOTH
CELLULAR
WI-FI
1822
DEVICES 1820
1824
NETWORK 1832

FIG. 18

DATA SEGMENTATION USING MACHINE LEARNING

TECHNICAL FIELD

An embodiment of the present subject matter relates generally to data segmentation and, more specifically, to data segmentation using machine learning.

BACKGROUND

Data segmentation is commonly used when analyzing data. As part of this process, data is segmented to into various categories to derive insights related to the specific category. For example, data may be segmented based on the source of the data to derive insights pertaining to each data source, as well as compare the data sources to each other. As another example, data may be segmented based on the time at which the data was collected to derive insights pertaining to each particular time range and how they relate to each other.

Currently, data segmentation is performed manually. For example, a user manually selects the parameters for segmenting data into categories, such as by selecting time ranges, data sources, etc. This process is not only slow and inefficient, but also dependent on the judgment of the user to derive insights from the data. Accordingly, improvements are needed.

BRIEF DESCRIPTION OF THE DRAWINGS

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 in which:

FIG. **1** shows a system for data segmentation using machine learning, according to some example embodiments.

FIG. **2** is a block diagram of a data segmentation system, according to some example embodiments.

FIG. **3** is a block diagram of a segmentation model training component, according to some example embodiments.

FIG. **4** is a flowchart showing a method for data segmentation using machine learning, according to some example embodiments.

FIG. **5** is a flowchart showing a method for prioritizing a set of parameter values, according to some example embodiments.

FIG. **6** is a flowchart showing a method for determining a set of threshold segmentation values, according to some example embodiments.

FIG. **7** is a flowchart showing a method for data segmentation of users using machine learning, according to some example embodiments.

FIG. **8** is a flowchart showing a method for segmenting users based on user lifetime value, according to some example embodiments.

FIG. **9** is a flowchart showing a method for segmenting users based on user an interaction history, according to some example embodiments.

FIG. **10** is a flowchart showing a method for data segmentation of items using machine learning, according to some example embodiments.

FIG. **11** is a flowchart showing a method for segmenting items based on an arrival, according to some example embodiments

FIG. **12** is a flowchart showing a method for segmenting items based on estimated purchase times, according to some example embodiments.

FIG. **13** is a flowchart showing a method for data segmentation of users based on loyalty value using machine learning, according to some example embodiments.

FIG. **14** is a flowchart showing a method for providing personalized promotions based on user segments, according to some example embodiments.

FIG. **15** is a flowchart showing a method for providing personalized engagement based on configuration parameters, according to some example embodiments

FIG. **16** is a flowchart showing a method for determining that a triggering condition has been satisfied, according to some example, embodiments.

FIG. **17** is a block diagram illustrating components of a machine, according to some example embodiments, able 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.

FIG. **18** is a block diagram illustrating components of a machine, according to some example embodiments, able 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.

DETAILED DESCRIPTION

In the following description, for purposes of explanation, various details are set forth in order to provide a thorough understanding of some example embodiments. It will be apparent, however, to one skilled in the art, that the present subject matter may be practiced without these specific details, or with slight alterations.

Reference in the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present subject matter. Thus, the appearances of the phrase "in one embodiment" or "in an embodiment" appearing in various places throughout the specification are not necessarily all referring to the same embodiment.

For purposes of explanation, specific configurations and details are set forth in order to provide a thorough understanding of the present subject matter. However, it will be apparent to one of ordinary skill in the art that embodiments of the subject matter described may be practiced without the specific details presented herein, or in various combinations, as described herein. Furthermore, well-known features may be omitted or simplified in order not to obscure the described embodiments. Various examples may be given throughout this description. These are merely descriptions of specific embodiments. The scope or meaning of the claims is not limited to the examples given.

Disclosed are systems, methods, and non-transitory computer-readable media for data segmentation using machine learning. A data segmentation system provides for predictive data segmentation of data using machine learning models generated from training data describing users and/or inventory items. The training data describing each user and/or inventory item is comprised of a set of parameter values corresponding to a set of parameters. The training data is initially segmented into a set of predetermined categories. The data segmentation system uses linear regression to

analyze the sets of parameter values included in each of the categories to determine a signal strength value for each individual parameter at predicting the categorization of the data (e.g., user or inventory item) into one of the predetermined categories. For example, parameters determined to be a strong signal of the proper categorization of the data may be assigned a relatively high signal strength value, whereas, parameters determined to be a weak signal of the proper categorization of the data may be assigned a relatively lower signal strength value.

The data segmentation system ranks the parameters based on the determined signal strength values, such as by ranking the parameters from the parameter with the highest signal strength value to the parameter with the lowest signal strength value. The data segmentation system uses the ranking to select a subset of the parameter to use in segmenting data into the predetermined categories, such as by selection the parameters that provide the strongest signal for predicting the categorization of the data.

The data segmentation system may also determine weights to assign to the various parameters based on the ranking. For example, parameters with a relatively higher signal strength value may be given greater weight that parameters with a relatively lower signal strength value.

The data segmentation system uses the ranking of the parameters along with the sets of parameter values included in the training data to determine threshold segmentation values used for segmenting data into the predetermined categories. For example, the data segmentation system calculates a set of averaged parameter values based on the set of parameter values included in each category. The data segmentation system may then apply weights to the averaged parameters values based on the ranking of the parameters. For example, parameters determined to have a higher signal strength value are given greater weight than parameters having a lower signal strength value.

The data segmentation system uses the resulting weighed averaged parameter values to determine threshold segmentation values for segmenting data into the predetermined categories. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each category.

The data segmentation system uses the threshold segmentation values to automatically segment data into one of the categories. For example, the data segmentation system determines a segmentation value based on a set of parameter values describing a user and/or inventory item and then assigns the user and/or inventory item to one of the categories based on the segmentation value range encompassing the segmentation value.

The functionality of the data segmentation system can be used to segment any of a variety of types of data, such as data representing users, inventory items, and the like. Further, the data segmentation system may be used to segment data into any desired type of category, such as predicting a customer value level, customer purchasing type, customer loyalty level, item popularity, and the like. The data segmentation system may also derive correlations between the segmented data, such as by identifying correlation and/or affinities between segments of users and items. The segmentation and determined correlations may be used to provide customized interactions/engagement with users, generate personalized recommendations, generate personalized offers, and the like.

FIG. **1** shows a system **100** for data segmentation using machine learning, according to some example embodiments. As shown, multiple devices (i.e., client device **102**, client device **104**, service provider system **106**, and data segmentation system **108**) are connected to a communication network **110** and configured to communicate with each other through use of the communication network **110**. The communication network **110** is any type of network, including a local area network (LAN), such as an intranet, a wide area network (WAN), such as the internet, a telephone and mobile device network, such as cellular network, or any combination thereof. Further, the communication network **110** may be a public network, a private network, or a combination thereof. The communication network **110** is implemented using any number of communication links associated with one or more service providers, including one or more wired communication links, one or more wireless communication links, or any combination thereof. Additionally, the communication network **110** is configured to support the transmission of data formatted using any number of protocols.

Multiple computing devices can be connected to the communication network **110**. A computing device is any type of general computing device capable of network communication with other computing devices. For example, a computing device can be a personal computing device such as a desktop or workstation, a business server, or a portable computing device, such as a laptop, smart phone, or a tablet personal computer (PC). A computing device can include some or all of the features, components, and peripherals of the machine **1800** shown in FIG. **18**.

To facilitate communication with other computing devices, a computing device includes a communication interface configured to receive a communication, such as a request, data, and the like, from another computing device in network communication with the computing device and pass the communication along to an appropriate module running on the computing device. The communication interface also sends a communication to another computing device in network communication with the computing device.

The service provider system **106** is one or more computing devices associated with a service provider that utilizes the functionality of the data segmentation system **108**. A service provider may be a person, business, company, and/or any other type of entity that uses the services provided by the data segmentation system **108**.

The service provider may use the functionality of the data segmentation system **108** as part of a service provided by the service provider. The service provider may provide any type of service, such as a banking service, travel service, retail service, and the like. The service may be an online and/or offline service. That is, the service may be available only online, such as an online retailer, offline, such as a physical retailer, or both online and offline, such as a retailer that provides a website or application as well as a physical retail store.

The service provider system **106** may facilitate any service of a service provider that is provided online, such as a ride-sharing service, reservation service, retail service, news service, and the like. In these types of embodiments, users (e.g., customers of the service provider) may interact with the service provider system **106** to utilize the online service provided by the service provider. Users communicate with and utilize the functionality of the service provider system **106** by using the client devices **102** and **104** that are connected to the communication network **110** by direct and/or indirect communication. The service provider system **106**, however, does not have to provide an online service that is accessible to users. That is, the service provider system **106** may simply be a computing system used by a

service provider to perform any type of functionality, such as manage inventory, maintain transaction data, maintain customer records, and the like.

Although the shown system **100** includes only two client devices **102**, **104** and one service provider system **106**, this is only for ease of explanation and is not meant to be limiting. The system **100** can include any number of client devices **102**, **104** and/or service provider systems **106**. Further, each service provider system **106** may concurrently accept communications from and/or interact with any number of client devices **102**, **104**, and support connections from a variety of different types of client devices **102**, **104**, such as desktop computers; mobile computers; mobile communications devices, e.g., mobile phones, smart phones, tablets; smart televisions; set-top boxes; and/or any other network enabled computing devices. Hence, the client devices **102** and **104** may be of varying type, capabilities, operating systems, and so forth.

A user interacts with a service provider system **106** via a client-side application installed on the client devices **102** and **104**. In some embodiments, the client-side application includes a component specific to the service provider system **106**. For example, the component may be a stand-alone application, one or more application plug-ins, and/or a browser extension. However, users may also interact with the service provider system **106** via a third-party application, such as a web browser or messaging application, that resides on the client devices **102** and **104** and is configured to communicate with the service provider system **106**. In either case, the client-side application presents a user interface (UI) for the user to interact with the service provider system **106**. For example, the user interacts with the service provider system **106** via a client-side application integrated with the file system or via a webpage displayed using a web browser application.

The data segmentation system **108** provides data segmentation functionality for service providers. A service provider may utilize data segmentation for a variety of reasons, such as to analyze data, identify correlations between data, implement personalized engagement with users, generate personalized recommendations, generate personalized offers/promotions, and the like.

As an example, a service provider providing a retail service may use data segmentation to better understand and engage with their users (e.g., customers). For example, the service provider may segment the users into categories indicating a value level of the user to the service provider (e.g., high value, medium value, low value). The service provider may then engage with the users in a personalized manner based on the segmentation. For example, the service provider may provide different incentives or promotions to users categorized as high value users versus users that are categorized as medium or low value users.

As another example, a service provider providing a retail service may segment users into categories indicating the loyalty level of the user, such as whether a user is a loyal customer, at-risk customer, or lost customer. The service provider may then engage with the users in a personalized manner based on the segmentation. For example, the service provider may provide personalized incentives or promotions to at-risk customers in an effort to retain the customers and/or turn the at-risk customers into loyal customers.

To utilize the functionality of the data segmentation system **108** service providers provide the data segmentation system **108** with data collected using the service provider system **106**. The data may be collected from various computing devices and locations. For example, the data may include data gathered by cloud-based servers of service provider system **106** that facilitate a website and/or online service of the service provider. As another example, the data may include data gathered by computing devices included in the service provider system **106** that are implemented at physical locations associated with the service provider, such as point of sale (POS) systems, customer tracking systems, and the like.

The data may include any of a variety of types of data gathered by the service provider. For example, the data may include data describing the service provider's users, individual transactions (purchases, reservations, transfers), and/or any other type of user interactions with the service provider. Other types of interactions include use of the services providers website (e.g., page views, items added to cart, etc.), communications with the service provider's representatives and/or agents (e.g., support representatives, sales agents, etc.), visits to the service provider's physical locations (e.g., store visits), and the like. The data may also include data describing inventory items offered for sale by the service provider. For example, the data may include data identifying the inventory items (e.g., stock keeping unit (SKU) codes), a quantity of the inventory items, the location of the inventory items (e.g., retail store, warehouse, etc.), inventory item type (e.g., pants, shirt, etc.), description of the inventory items (e.g., color, size, etc.), and the like.

The data may be aggregated and/or normalized to describe individual users and/or individual inventory items. For example, data associated with each individual user and/or inventory item may be used to calculate parameter values corresponding to a set of parameters for describing the individual user and/or inventory item. The parameters may include any parameter for describing a user or inventory item. For example, the set of parameters may include parameters that describe a user's interaction history with the service provider, such as an average cart size of the user, a frequency at which the user interacts with the service provider, a purchase history of the user, a recency of the user's latest interaction with the service provider, a user lifetime value (LTV) to the service provider, and the like. The parameters may also include data describing an inventory item, such as an item type, color, size, an average time to sale of the item, an average sale price at which the inventory item was purchased, an average expiration duration of the item, and the like. The parameter values may be calculated by the service provider system **106** prior to transmission of the data to the data segmentation system **108** and/or by the data segmentation system **108**.

The data segmentation system **108** uses the data received from the service provider system **106** to provide automated data segmentation for the service provider, as well as any associated functionality (e.g., determining data correlations, personalized engagement, recommendations, etc.). For example, the data is initially used to generate training data for selecting and/or prioritizing individual parameters used for automatic segmentation of the data into a set of predetermined categories. The training data is segmented into the set of predetermined categories by human reviewers and/or according to a predetermined set of criteria or rules. This segmentation may be performed by the service provider prior to transferring the data to the data segmentation system **108** and/or after the data is received by the data segmentation system **108**. The data is segmented to place each set of parameter values describing an individual user or inventory item into a category from the set of predetermined categories. For example, data associated with users may be segmented into categories indicating a determined value of the

user, loyalty level of the user, and the like. As another example, the data associated with inventory items may be segmented into categories indicating a popularity of the item, shelf life of the item, and the like.

The data segmentation system **108** uses linear regression to analyze the sets of parameter values included in each of the categories to determine a signal strength value for each individual parameter at predicting the categorization of the data (e.g., user or inventory item) into one of the predetermined categories. Parameters determined to be a strong signal of the proper categorization of the data may be assigned a relatively high signal strength value. In contrast, parameters determined to be a weak signal of the proper categorization of the data may be assigned a relatively lower signal strength value.

The data segmentation system **108** ranks the parameters based on the determined signal strength values and may use the ranking to automatically segment data into the categories. For example, the data segmentation system **108** may use the ranking to select a subset of the parameters for use in segmenting data and/or to determine weights to assign to the various parameters when segmenting data.

The data segmentation system **108** uses the ranking along with the parameter values included in the training data to determines threshold segmentation values used for segmenting data (e.g., user or inventory item) into the predetermined categories. For example, the data segmentation system **108** calculates a set of averaged parameter values based on the individual sets of parameter values included in each category. The data segmentation system **108** may then apply weights to the averaged parameters values based on the ranking of the parameters. For example, parameters determined to have a higher signal strength value are given greater weight than parameters having a lower signal strength value.

The data segmentation system **108** uses the resulting weighed averaged parameter values to determine threshold segmentation values for the various categories. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each category. The data segmentation system **108** subsequently uses the threshold segmentation values to automatically segment data into one of the categories. For example, the data segmentation system **108** determines a segmentation value based on a set of parameter values describing a user and/or inventory item then assigns the set data to one of the categories based on the segmentation value range encompassing the segmentation value.

The functionality of the data segmentation system **108** can be used to segment any of a variety of types of data, such as data representing users, items, and the like. Further, the data segmentation system **108** may segment data into any desired type of category, such as categories indicating a customer value level, customer purchasing type, customer loyalty level, item popularity, and the like. The data segmentation system **108** may also derive correlations between the segmented data, such as by identifying correlation and/or affinities between segments of users and inventory items. The segmentation and correlations may be used to provide customized interaction/engagement with users, generate personalized recommendations, generate personalized offers, and the like.

FIG. **2** is a block diagram of a data segmentation system **108**, according to some example embodiments. To avoid obscuring the inventive subject matter with unnecessary detail, various functional components (e.g., modules) that are not germane to conveying an understanding of the inventive subject matter have been omitted from FIG. **2**. However, a skilled artisan will readily recognize that various additional functional components may be supported by the data segmentation system **108** to facilitate additional functionality that is not specifically described herein. Furthermore, the various functional modules depicted in FIG. **2** may reside on a single computing device or may be distributed across several computing devices in various arrangements such as those used in cloud-based architectures.

As shown, the data segmentation system **108** includes a data accessing component **202**, a segmentation model training component **204**, an automated data segmentation component **206**, a data correlation component **208**, an engagement management component **210**, and a data storage **212**.

The data accessing component **202** accesses data from a service provider for use by the data segmentation system **108**. The accessed data may include any of a variety of types of data provided by the service provider to be segmented by the data segmentation system **108**. The data accessing component **202** may access the data by receiving transmissions from a service provider system **106**. As another example, the data accessing component **202** may periodically query the service provider system **106** for data.

The data accessed from the service provider system **106** may include data collected from various computing devices and locations. For example, the data may include data gathered by cloud-based servers of the service provider system **106** that facilitate a website and/or online service of the service provider. As another example, the data may include data gathered by computing devices included in the service provider system **106** that are implemented at physical locations associated with the service provider, such as point of sale (POS) systems, customer tracking systems, and the like.

The data may include any of a variety of types of data gathered by the service provider. For example, the data may include data describing the service provider's users, individual transactions (purchases, reservations, transfers), and/or any other type of user interactions with the service provider. Other types of interactions include use of the services providers website (e.g., page views, items added to cart, etc.), communications with the service provider's representatives and/or agents (e.g., support representatives, sales agents, etc.), visits to the service provider's physical locations (e.g., store visits), and the like. The data may also include data describing inventory items offered for sale by the service provider. For example, the data may include data identifying the inventory items (e.g., stock keeping unit (SKU) codes), a quantity of the inventory items, the location of the inventory items (e.g., retail store, warehouse, etc.), inventory item type (e.g., pants, shirt, etc.), description of the inventory items (e.g., color, size, etc.), and the like.

The data may be aggregated and/or normalized to describe individual users and/or individual inventory items. For example, data associated with each individual user and/or inventory item may be used to calculate a set of parameter values corresponding to a set of parameters for describing the individual user and/or inventory item. The parameters may include any parameter for describing a user or inventory item. For example, the set of parameters may include parameters that describe a user's interaction history with the service provider, such as an average cart size of the user, a frequency at which the user interacts with the service provider, a purchase history of the user, a recency of the user's latest interaction with the service provider, a user lifetime value (LTV), and the like. The parameters may also include data describing an inventory item, such as an item

type, color, size, an average time to sale of the item, an average sale price at which the inventory item was purchased, an average expiration duration of the item, and the like. The parameter values may be calculated by the service provider system **106** prior to transmission of the data to the data segmentation system **108** and/or by the data segmentation system **108**.

The data accessing component **202** may store the data accessed from the service provider system **106** in the data storage **212**, where it may be accessed by the other components of the data segmentation system **108**. The data accessing component **202** may associate the stored data with an identifier for the service provider from which the data was accessed.

The segmentation model training component **204** generates segmentation models (e.g., machine learning models) for automatically segmenting data into predetermined categories for a service provider. For example, the segmentation models generated by the segmentation model training component **204** receive input data describing a user or inventory item and provide an output segmenting the user or inventory item into a specific category.

The segmentation model training component **204** initially trains the segmentation models using training data describing users or inventory items that have been categorized into a set of predetermined categories. The training data may include a set of parameter values corresponding to a set of parameters for describing a user or inventory item. For example, the set of parameters may include individual parameters describing different aspects or features of a user or inventory item, such as demographic data describing a user (e.g., age, geographic location, sex), an interaction history of the user (e.g., purchase amount, purchasing frequency, cart size, interaction recency), data describing an item (e.g., item type, color, size, shelf life), interaction history of the item (e.g., average time to sale), and the like. The training data may be categorized into any desired set of predetermined categories by human reviewers and/or based on a set of predetermined criteria.

In some embodiments, the segmentation model training component **204** uses linear regression to analyze the set of parameter values included in each of the categories to determine signal strength values for the individual parameters. The signal strength value determined for a parameter indicates the strength of the parameter at predicting the categorization of the data (e.g., user or inventory item) into one of the predetermined categories. For example, parameters determined to be a strong signal of the proper categorization of the data may be assigned a relatively high signal strength value, whereas parameters determined to be a weak signal of the proper categorization of the data may be assigned a relatively lower signal strength value.

The segmentation model training component **204** may use the resulting signal strength values to rank the individual parameters. For example, the parameter values may be ranked from the parameter with the highest signal strength value to the parameter with the lowest signal strength value. In some embodiments, the segmentation model training component **204** may select a subset of the parameters based on the ranking for use by a segmentation model to segment data into the categories. For example, the segmentation model training component **204** may select a predetermined number of the highest ranked parameters, such as the top 4 or 5 highest ranked parameters. As another example, the segmentation model training component **204** may select a subset of the parameters that have a signal strength value that meets or exceeds a threshold signal strength value.

In this way, the segmentation model training component **204** provides for automated selection of the parameters that are best suited for predicting the categorization of data into the predetermined categories. This provides a technical improvement by limiting the number of parameters that are used by the resulting segmentation model to categorize data. For example, selecting a subset of the possible parameters for use by the segmentation model reduces the number of computations performed by the segmentation model to categorize the data, thereby increasing the perceived speed at which the segmentation model performs the segmentation of the data.

The segmentation model training component **204** also determines weight values for the parameters based on the ranking. The weight values provide greater weight to parameters that are stronger signals for predicting the categorization of data (e.g., user, inventory item) into the predetermined categories. For example, the segmentation model training component **204** assigns higher weight values to parameters with relatively higher signal strength values than to parameters with relatively lower signal strength values.

The segmentation model training component **204** uses the weight values and the selected parameters to determine threshold segmentation scores for categorizing data into the predetermined categories. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each category. To calculate the threshold segmentation value, the segmentation model training component **204** calculates a set of averaged parameter values based on the individual sets of parameter values included in each category. The segmentation model training component **204** may then apply the determined weights to the averaged parameters value, resulting in a set of weighted averaged parameter values. The segmentation model training component **204** uses the weighed averaged parameter values to then determine threshold segmentation values for the various categories.

Linear regression and threshold segmentation values is just one example, of how the segmentation model training component **204** may generate a segmentation model for segmenting data into the predetermined categories. In other embodiments, the segmentation model training component **204** may generate a classification model for segmenting data. In this type of embodiment, the segmentation model training component **204** may generate training vectors based on the training data. Each training vector may represent a single user or inventory item described in the training data as well as the category into which the user or inventory item has been segmented. The training vectors may be generated based on each pf the parameters included in the training data or a selected subset of the parameters, as described above. The segmentation model training component **204** may generate the training vectors using any of a variety of known algorithms or machine learning models for the generating vector representations of data.

The segmentation model training component **204** may use the resulting training vectors to train a classification model that outputs a set of probability values corresponding to a set of labels. Each label corresponds to one of the predetermined categories and each probability value indicates the likelihood that one of the labels properly classifies the input data.

The segmentation model training component **204** may generate multiple segmentation models for a service provider. For example, the segmentation model training component **204** may generate segmentation models for segmenting different types of data, such as users and inventory items.

The segmentation model training component **204** may generate segmentation models for segmenting data into different types of categories, such as categories describing the value of a customer, the type of customer, the popularity of an item, and the like.

The segmentation model training component **204** may also generate individual segmentation models for different channels or locations associated with a service provider. For example, the segmentation model training component **204** may generate separate segmentation models for each retail location of a service provider or for groups of retail locations, such as a regional grouping of retail locations. As another example, the segmentation model training component **204** may generate different segmentation models based on different channels, such as a segmentation model for online services provided by the service provider and separate segmentation modes for physical retail locations. As another example, the segmentation model training component **204** may generate different segmentation models for different websites or portions of a singular website provided a service provider.

The segmentation model training component **204** stores the generated segmentation models in the data storage **212**, where they may be accessed by the other components of the data segmentation system **108**. The segmentation model training component **204** may also further refine the generated segmentation models based on subsequent training data and feedback. For example, manual reviewers may provide feedback indicating whether the output of a segmentation model properly segmented data. The segmentation model training component **204** may use the feedback data along with any additional training data to further refine the segmentation models, such as by adjusting the signal strength values for the various parameters, selecting different parameters for use by the segmentation model, adjusting the weight values, adjusting the threshold segmentation values, retraining a classification model, and the like.

The automated data segmentation component **206** provides automatic data segmentation for a service provider. This may include segmenting data (e.g., users, inventory items) into categories based on a set of rules provided by a service provider as well as predictive segmentation using the segmentation models generated by the segmentation model training component **204**.

A service provider may configure a set of rules for segmenting users and/or inventory items into segments based on data received from the service provider computing system **106**. For example, the rules may be based on interaction data, sales data, inventory data, and the like.

In some embodiments, the automated data segmentation component **206** may segment users based on user engagement, such as based on user purchase history, interactions with the service provider's website and/or physical retail locations, and the like. For example, the automated data segmentation component **206** may segment users into either a one-time interaction category indicating that the user has performed a single interaction (e.g., purchase, store visit) within a given time frame, or a repeat interaction category, indicating that the user has performed multiple interactions with the service provider within a given time frame.

The automated data segmentation component **206** may further segment the users into subcategories based on an elapsed period of time after a most recent interaction of the user. For example, users in the one-time interaction category may be further segmented into categories indicating whether the user is a potential repeat customer, at-risk customer, or lost customer. Similarly, users segmented in the repeat interaction category may be further segmented into subcategories indicating whether the user is a loyal customer, breakaway customer, at-risk customer, or lost customer.

As another example, the automated data segmentation component **206** may segment users based on a behavior classification of the user, such as whether the user is a full price shopper, a value shopper, a trend setter, and/or a trend follower that purchases items. In this type of embodiment, the rules defined by a service provider may indicate criteria for segmenting the users into the categories. For example, the rules may dictate a threshold percentage of purchases made at full price and/or a discounted price for segmenting users as either a full price shopper or a value shopper. Similarly, the rules may dictate a threshold period of time for purchasing an inventory after its initial release for segmenting users as either a trend setter or trend follower.

These are just some examples of segmenting users and are not meant to be limiting. The automated data segmentation component **206** may segment users based on a variety of other criteria, such as age, location, gender, user LTV, and the like. Similarly, the automated data segmentation component **206** may segment inventory items based on a variety of factors, such as item type, color, location, and the like. The automated data segmentation component **206** may also segment inventory items based on how recently the inventory items were received/released (e.g., new arrival), a popularity of the item (e.g., best seller), how quickly the item sells (e.g., hot item, slow mover), and the like.

As will be explained in greater detail below, segmentation of the users and/or inventory items may be used for personalized engagement with users, identifying affinities/correlations between segments of users and/or inventory items, generating personalized recommendations, and/or presenting analytics. The automated data segmentation component **206** may store data identifying the segmentation of the users and/or inventory items in the data storage **212**, where the data may be accessible by the other components of the data segmentation system **108**.

The automated data segmentation component **206** may also segment users and inventory items using the segmentation models generated by the segmentation model training component **204**. For example, the automated data segmentation component **206** may access the trained segmentation models from the data storage **212** for use in segmenting users or inventory items. To use the generated segmentation models, the automated data segmentation component **206** generates an input to be used with the segmentation model based on a set of data associated with a user or inventory item. For example, the automated data segmentation component **206** may generate an input using a similar technique used by the segmentation model training component **204** to generate the segmentation model. That is, the automated data segmentation component **206** may use the same set of parameters and parameter rankings used to generate the segmentation model or the same parameters and vector generation algorithm used to generate the segmentation model (e.g., classification model).

In embodiments in which the segmentation model is generated using threshold segmentation values, the automated data segmentation component **206** may generate a set of parameter values from data describing a user or inventory item and apply weights to the parameter values based on the parameter ranking determined for the particular segmentation model. The automated data segmentation component **206** may then calculate a segmentation value for the user or inventory item based on the set of parameter values, which

is compared to the threshold segmentation values to determine the proper segmentation of the user or inventory item.

In embodiments in which the segmentation model is a classification model, the automated data segmentation component **206** generates an input vector based on the set of parameters and parameter ranking determined for the particular segmentation model. The automated data segmentation component **206** may use the resulting input vector as input to the classification model, which provides a set of probability values for the various labels. The automated data segmentation component **206** identifies the classification label with the highest probability score and segments the user or inventory item into the category corresponding to the identified classification label.

The data correlation component **208** identifies correlations between data based on the segmentation performed by the automated data segmentation component **206**. For example, the data correlation component **208** may determine correlations between users and inventory items, such as by identifying affinities between users and inventory items. That is, the data correlation component **208** may identify inventory items or categories of inventory items that particular users have an affinity towards.

To accomplish this, the data correlation component **208** may analyze data associated with inventory items in a particular category to identify users that have interacted with the items in the category. For example, the data correlation component **208** may identify users that purchased the items included in the category. The data correlation component **208** may then analyze data associated with the identified users to determine common segmentations of the users, indicating a correlation between the user segmentation and the inventory segmentation.

As another example, the data correlation component **208** may analyze data associated with inventory items purchased by a segmentation of user to determine the types of inventory items that users in the segmentation of users may like. For example, the data correlation component **208** may identify inventory items that are commonly purchased my users included in the segment. The data correlation component **208** may then use parameters describing the inventory items, such as color, item, type, and the like, to identify other users that may be of interest to the users in the segment. The data correlation component **208** may store data defining the determined affinities between users and/or inventory items in the data storage **212**.

The engagement management component **210** manages personalized engagement with users based on the segmentation of the users and/or items. Personalized engagement includes providing a user with a recommendation and/or promotion that is selected, generated, and/or delivered based on the specific user. For example, a user that is a trend setter may be provided with a recommendation to purchase a newly released item. As another example, a user that is determined to be an at-risk customer may be provided with a promotional offer to in an effort to retain the user and/or turn the user from an at-risk customer into a loyal customer. As another example, a user that is a trend setter may be provided with a promotion to receive early access to a newly released item, whereas a user that is cost conscious may be provided with a promotion offering a discount to purchase the item.

The engagement management component **210** performs personalized engagement based on configuration parameters provided by a service provider. The configuration parameters may define configurations, triggers, and/or constraints for generating personalized engagement. For example, the configuration parameters may include triggers for engaging users. A trigger is one or more conditions that, if met, causes performance of a specified engagement. For example, the engagement may be transmitting a message and/or promotion to a user, sending a recommendation to a user, and the like.

The triggers may include any type of conditions. For example, a triggering condition may be detecting a change in the segmentation of a user, such as detecting a change in the segmentation of a user a loyal customer to an at-risk customer. As another example, a triggering condition may be based on detecting a change in segmentation of an item, such as an item changing segmentation from a hot item to a slow mover. As another example, a triggering condition may be based on a remaining time until an expiration date of an item, such as an item being within one week of expiring. These are just some examples of triggering conditions and are not meant to be limiting. The configuration parameters may utilize any of a variety of type and combinations of triggering conditions.

The configuration parameters may also include configurations and constraints for engagements that are sent to users. For example, the configurations may identify rules for selecting users to received promotions when a triggering condition has been satisfied. In some embodiments, the rules may identify a specific segmentation or segmentations of users to receive an engagement. For example, a rule may identify that users segmented as value shoppers to receive a promotion for an item that is nearing its expiration date. As another example, a rule may identify that users determined to have an affinity for item se receive a promotion for the item when a specified triggering condition is satisfied.

The constraints included in the configuration parameters may identify constraints on the types or extent of promotions that may be provided to a user. For example, the promotions may include a maximum discounted amount or percentage that may be offered to a user as a promotion. As another example, the constraints may identify a constraint on a number of users that may receive the promotions. These are just some examples of configurations and constraints that may be included in the configuration parameters and are not meant to be limiting. The configuration parameters may include any of a variety of types of configurations and promotions.

FIG. **3** is a block diagram of a segmentation model training component **204**, according to some example embodiments. To avoid obscuring the inventive subject matter with unnecessary detail, various functional components (e.g., modules) that are not germane to conveying an understanding of the inventive subject matter have been omitted from FIG. **3**. However, a skilled artisan will readily recognize that various additional functional components may be supported by the segmentation model training component **204** to facilitate additional functionality that is not specifically described herein. Furthermore, the various functional modules depicted in FIG. **3** may reside on a single computing device or may be distributed across several computing devices in various arrangements such as those used in cloud-based architectures.

As shown, the segmentation model training component **204** includes a training data component **302**, a parameter ranking component **304**, a parameter selection component **306**, a parameter weight determination component **308**, an average parameter value determination component **310**, a parameter weighting component **312**, a segmentation threshold calculation component **314**, and a classification model training component **316**.

The training data component **302** accesses and/or generates training data for training a data segmentation model. A data segmentation model is a model that segments data describing a user or inventory item into a category from a predetermined set of categories. The training data may include a set of parameter values corresponding to a set of parameters for describing a user or inventory item. For example, the set of parameters may include individual parameters describing different aspects or features of a user or inventory item, such as demographic data describing a user (e.g., age, geographic location, sex), an interaction history of the user (e.g., purchase amount, purchasing frequency, cart size, interaction recency), data describing an item (e.g., item type, color, size, shelf life), interaction history of the item (e.g., average time to sale), and the like. The training data may be categorized into any desired set of predetermined categories by human reviewers and/or based on a set of predetermined criteria.

The parameter ranking component **304** determines a prioritization and/or ranking of various parameters that describe a user and/or inventory item. The parameter ranking component **304** determines the prioritization by uses linear regression to analyze the set of parameter values included in each of the categories of training data. The linear regression provides signal strength values for the individual parameters. The signal strength value determined for each parameter indicates the strength of the parameter at predicting the categorization of the data (e.g., user or inventory item) into one of the predetermined categories. For example, parameters determined to be a strong signal of the proper categorization of the data may be assigned a relatively high signal strength value, whereas parameters determined to be a weak signal of the proper categorization of the data may be assigned a relatively lower signal strength value. The parameter ranking component **304** may use the resulting signal strength values to rank the individual parameters. For example, the parameter values may be ranked from the parameter with the highest signal strength value to the parameter with the lowest signal strength value.

The parameter selection component **306** selects a subset of the parameter values based on the ranking. In some embodiments, a subset of the parameters may be selected based on the ranking for use by a segmentation model to segment data into the categories. For example, the parameter selection component **306** may select a predetermined number of the highest ranked parameters, such as the top 4 or 5 highest ranked parameters. As another example, the parameter selection component **306** may select a subset of the parameters that have a signal strength value that meets or exceeds a threshold signal strength value.

In this way, the parameter selection component **306** provides for automated selection of the parameters that are best suited for predicting the categorization of data into the predetermined categories. This provides a technical improvement by limiting the number of parameters that are used by the resulting segmentation model to categorize data. For example, selecting a subset of the possible parameters for use by the segmentation model reduces the number of computations performed by the segmentation model to categorize the data, thereby increasing the perceived speed at which the segmentation model performs the segmentation of the data.

Use of the parameter selection component **306** to select a subset of the parameters is optional. For example, in some embodiments, each of the parameters is used by the resulting segmentation model, rather than a subset of the parameters.

The parameter weight determination component **308** determines weight values for the parameters based on the ranking. The weight values provide greater weight to parameters that are stronger signals for predicting the categorization of data (e.g., user, inventory item) into the predetermined categories. For example, the parameter weight determination component **308** assigns higher weight values to parameters with relatively higher signal strength values than to parameters with relatively lower signal strength values.

The average parameter value determination component **310** calculates a set of averaged parameter values based on the individual sets of parameter values included in each category. For example, the average parameter value determination component **310** may access the individual parameter values corresponding to a single parameter from each set of parameter values in the category and determine an average parameter value based on the set of individual parameter values. The average parameter value determination component **310** may repeat this process for each of the parameters to determine the set of averaged parameter values for each category.

The parameter weighting component **312** applies weights to the sets of averaged parameter values for each category. For example, the parameter weighting component **312** applies the weights determined by the parameter weight determination component **308** to the averaged parameter values in each set of averaged parameters values, resulting in sets of weighted averaged parameter values for each category.

The segmentation threshold calculation component **314** calculates segmentation threshold values for each category based on the sets of weighted averaged parameter values. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each category. For example, the segmentation threshold calculation component **314** may calculate the segmentation threshold values by determining an overall segmentation value based on each set of weighted averaged parameter values. This may include determining an average of the individual values in the set of weighted averaged parameter values, a sum of the individual values in the set of weighted averaged parameter values, and the like.

The resulting overall segmentation values may be the threshold segmentation values or used to calculate the threshold segmentation values. For example, the segmentation threshold calculation component **314** may use the overall segmentation values for each category to determine threshold segmentation values that encompass the overall segmentation values. In some embodiments, the segmentation threshold calculation component **314** may determine the threshold segmentation values by determining a value between two overall segmentation values, such as by selecting a value that is equal distance or near equal distance between the two overall segmentation values.

The classification model training component **316** trains a classification model for automatically segmenting data into categories. Linear regression and threshold segmentation values is just one example, of how the segmentation model training component **204** may generate a segmentation model for segmenting data into predetermined categories. In other embodiments, the classification model training component **316** may generate a classification model for segmenting data. In this type of embodiment, the classification model training component **316** generates training vectors based on the training data. Each training vector may represent a single user or inventory item described in the training data as well

as the category into which the user or inventory item has been segmented. The training vectors may be generated based on each pf the parameters included in the training data or a selected subset of the parameters, as described above. The classification model training component **316** may generate the training vectors using any of a variety of known algorithms or machine learning models for the generating vector representations of data.

The classification model training component **316** may use the resulting training vectors to train a classification model that outputs a set of probability values corresponding to a set of labels. Each label corresponds to one of the predetermined categories and each probability value indicates the likelihood that one of the labels properly classifies the input data.

FIG. **4** is a flowchart showing a method **400** for data segmentation using machine learning, according to some example embodiments. The method **400** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **400** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **400** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **400** may be deployed on various other hardware configurations and the method **400** is not intended to be limited to the data segmentation system **108**.

At operation **402**, the data accessing component **202** accesses data describing historical interactions performed in relation to a service. The data accessing component **202** accesses data from a service provider that provides the service. The service may include the service provider overall or a subset of the services provided by a service provider, such as a particular physical location (e.g., retail store) or channel associated with the service provider (e.g., online).

The accessed data may include any of a variety of types of data provided by the service provider to be segmented by the data segmentation system **108**. The data accessing component **202** may access the data by receiving transmissions from a service provider system **106**. As another example, the data accessing component **202** may periodically query the service provider system **106** for data.

The data accessed from the service provider system **106** may include data collected from various computing devices and locations. For example, the data may include data gathered by cloud-based servers of the service provider system **106** that facilitate a website and/or online service of the service provider. As another example, the data may include data gathered by computing devices included in the service provider system **106** that are implemented at physical locations associated with the service provider, such as point of sale (POS) systems, customer tracking systems, and the like.

The data may include any of a variety of types of data gathered by the service provider. For example, the data may include data describing the service provider's users, individual transactions (purchases, reservations, transfers), and/or any other type of user interactions with the service provider. Other types of interactions include use of the services providers website (e.g., page views, items added to cart, etc.), communications with the service provider's representatives and/or agents (e.g., support representatives, sales agents, etc.), visits to the service provider's physical locations (e.g., store visits), and the like. The data may also include data describing inventory items offered for sale by the service provider. For example, the data may include data identifying the inventory items (e.g., stock keeping unit (SKU) codes), a quantity of the inventory items, the location of the inventory items (e.g., retail store, warehouse, etc.), inventory item type (e.g., pants, shirt, etc.), description of the inventory items (e.g., color, size, etc.), and the like.

The data may be aggregated and/or normalized to describe individual users and/or individual inventory items. For example, data associated with each individual user and/or inventory item may be used to calculate a set of parameter values corresponding to a set of parameters for describing the individual user and/or inventory item. The parameters may include any parameter for describing a user or inventory item. For example, the set of parameters may include parameters that describe a user's interaction history with the service provider, such as an average cart size of the user, a frequency at which the user interacts with the service provider, a purchase history of the user, a recency of the user's latest interaction with the service provider, a user lifetime value (LTV), and the like. The parameters may also include data describing an inventory item, such as an item type, color, size, an average time to sale of the item, an average sale price at which the inventory item was purchased, an average expiration duration of the item, and the like. The parameter values may be calculated by the service provider system **106** prior to transmission of the data to the data segmentation system **108** and/or by the data segmentation system **108**

At operation **404**, the training data component **302** generates data clusters representing segments of the interaction data. The data clusters are used to train a segmentation model. The data clusters may be generated based on categorizations determined by human reviewers and/or according to a predetermined set of criteria or rules. The data clusters may each represent a predetermined category for segmenting the data.

At operation **406**, the parameter ranking component **304** prioritizes a set of parameters based on the interaction data included in each data cluster. The parameter ranking component **304** determines a prioritization and/or ranking of various parameters included in the data, such as parameters that describe a user and/or inventory item.

The parameter ranking component **304** determines the prioritization by uses linear regression to analyze the set of parameter values included in each of the data clusters. The linear regression provides signal strength values for the individual parameters. The signal strength value determined for each parameter indicates the strength of the parameter at predicting the categorization of the data (e.g., user or inventory item) into one of the predetermined categories. For example, parameters determined to be a strong signal of the proper categorization of the data may be assigned a relatively high signal strength value, whereas parameters determined to be a weak signal of the proper categorization of the data may be assigned a relatively lower signal strength value.

The parameter ranking component **304** may use the resulting signal strength values to rank the individual parameters. For example, the parameter values may be ranked from the parameter with the highest signal strength value to the parameter with the lowest signal strength value.

At operation **408**, the segmentation threshold calculation component **314** determines a set of threshold segmentation values for the service based on the prioritized set of parameters. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each category. To calculate the threshold segmentation value, the segmentation threshold calculation component **314** calculates a set of averaged parameter values based on

the individual sets of parameter values included in each data cluster. The segmentation threshold calculation component **314** may then apply weights determined based on the ranking of the parameters to the averaged parameters value, resulting in a set of weighted averaged parameter values. The segmentation threshold calculation component **314** uses the weighed averaged parameter values to then determine threshold segmentation values for the various categories.

FIG. **5** is a flowchart showing a method **500** for prioritizing a set of parameter values, according to some example embodiments. The method **500** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **500** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **500** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **500** may be deployed on various other hardware configurations and the method **500** is not intended to be limited to the data segmentation system **108**.

At operation **502**, the parameter ranking component **304** performs a linear regression based on interaction data included in each data cluster. The linear regression provides signal strength values for the individual parameters. The signal strength value determined for each parameter indicates the strength of the parameter at predicting the categorization of the data (e.g., user or inventory item) into one of the predetermined categories. For example, parameters determined to be a strong signal of the proper categorization of the data may be assigned a relatively high signal strength value, whereas parameters determined to be a weak signal of the proper categorization of the data may be assigned a relatively lower signal strength value.

At operation **504**, the parameter ranking component **304** ranks a set of parameters based on the linear regression. For example, the parameter ranking component **304** ranks the parameter values from the parameter with the highest signal strength value to the parameter with the lowest signal strength value.

At operation **506**, the parameter weight determination component **308** determines weight values for the set of parameters based on the ranking. The weight values provide greater weight to parameters that are stronger signals for predicting the categorization of data (e.g., user, inventory item) into the predetermined categories. For example, the parameter weight determination component **308** assigns higher weight values to parameters with relatively higher signal strength values than to parameters with relatively lower signal strength values.

FIG. **6** is a flowchart showing a method **600** for determining a set of threshold segmentation values, according to some example embodiments. The method **600** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **600** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **600** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **600** may be deployed on various other hardware configurations and the method **600** is not intended to be limited to the data segmentation system **108**.

At operation **602**, the average parameter value determination component **310** determines a set of average parameter values for each data cluster based on the sets of parameter values included in the data cluster. For example, the average parameter value determination component **310** may access the individual parameter values corresponding to a single parameter from each set of parameter values in the data cluster and determine an average parameter value based on the set of individual parameter values. The average parameter value determination component **310** may repeat this process for each of the parameters to determine the set of averaged parameter values for each data cluster (e.g., category).

At operation **604**, the parameter weighting component **312** applies weight values to each set of averaged parameter values. For example, the parameter weighting component **312** applies the weights determined by the parameter weight determination component **308** to the averaged parameter values in each set of averaged parameters values, resulting in sets of weighted averaged parameter values for each category.

At operation **606**, the segmentation threshold calculation component **314** determines a segmentation value for each data cluster based on the weighted set of parameter values for the data cluster. For example, the segmentation threshold calculation component **314** determines an average of the individual values in the set of weighted averaged parameter values, a sum of the individual values in the set of weighted averaged parameter values, and the like.

At operation **608**, the segmentation threshold calculation component **314** determines a set of threshold segmentation values based on the segmentation value for each data cluster. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each category corresponding to a data cluster. In some embodiments, the segmentation value determines for a data cluster may itself be the threshold segmentation values.

Alternatively, the segmentation threshold calculation component **314** may use the segmentation values to calculate the threshold segmentation values. For example, the segmentation threshold calculation component **314** may use the segmentation values for each data cluster to determine threshold segmentation values that encompass the segmentation values. In some embodiments, the segmentation threshold calculation component **314** may determine the threshold segmentation values by determining a value that falls between two separate segmentation values, such as by selecting a value that is equal distance or near equal distance between the two segmentation values.

FIG. **7** is a flowchart showing a method **700** for data segmentation of users using machine learning, according to some example embodiments. The method **700** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **700** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **700** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **700** may be deployed on various other hardware configurations and the method **700** is not intended to be limited to the data segmentation system **108**.

At operation **702**, the data accessing component **202** accesses interaction data describing historical interactions performed by a set of users in relation to a service. The data accessing component **202** accesses data from a service provider that provides the service. The service may include the service provider overall or a subset of the services provided by a service provider, such as a particular physical location (e.g., retail store) or channel associated with the service provider (e.g., online).

The accessed data may include any of a variety of types of data provided by the service provider to be segmented by the data segmentation system **108**. The data accessing com-

ponent **202** may access the data by receiving transmissions from a service provider system **106**. As another example, the data accessing component **202** may periodically query the service provider system **106** for data.

The data accessed from the service provider system **106** may include data collected from various computing devices and locations. For example, the data may include data gathered by cloud-based servers of the service provider system **106** that facilitate a website and/or online service of the service provider. As another example, the data may include data gathered by computing devices included in the service provider system **106** that are implemented at physical locations associated with the service provider, such as point of sale (POS) systems, customer tracking systems, and the like.

The data may include any of a variety of types of data gathered by the service provider. For example, the data may include data describing the service provider's users, individual transactions (purchases, reservations, transfers), and/or any other type of user interactions with the service provider. Other types of interactions include use of the services providers website (e.g., page views, items added to cart, etc.), communications with the service provider's representatives and/or agents (e.g., support representatives, sales agents, etc.), visits to the service provider's physical locations (e.g., store visits), and the like. The data may also include data describing inventory items offered for sale by the service provider. For example, the data may include data identifying the inventory items (e.g., stock keeping unit (SKU) codes), a quantity of the inventory items, the location of the inventory items (e.g., retail store, warehouse, etc.), inventory item type (e.g., pants, shirt, etc.), description of the inventory items (e.g., color, size, etc.), and the like.

The data may be aggregated and/or normalized to describe individual users and/or individual inventory items. For example, data associated with each individual user and/or inventory item may be used to calculate a set of parameter values corresponding to a set of parameters for describing the individual user and/or inventory item. The parameters may include any parameter for describing a user or inventory item. For example, the set of parameters may include parameters that describe a user's interaction history with the service provider, such as an average cart size of the user, a frequency at which the user interacts with the service provider, a purchase history of the user, a recency of the user's latest interaction with the service provider, a user lifetime value (LTV), and the like. The parameters may also include data describing an inventory item, such as an item type, color, size, an average time to sale of the item, an average sale price at which the inventory item was purchased, an average expiration duration of the item, and the like. The parameter values may be calculated by the service provider system **106** prior to transmission of the data to the data segmentation system **108** and/or by the data segmentation system **108**.

At operation **704**, the training data component **302** generates user segments based on the interaction data. The user segments include a subset of the user and are used to train a segmentation model. The user segments may be generated based on categorizations determined by human reviewers and/or according to a predetermined set of criteria or rules. The user segments may each represent a predetermined category for segmenting the users.

At operation **706**, the parameter ranking component **304** prioritizes a set of parameter values based on the interaction data included in each user segment. The parameter ranking component **304** determines a prioritization and/or ranking of various parameters included in the data, such as parameters that describe a user and/or inventory item.

At operation **708**, the segmentation threshold calculation component **314** determines a set of threshold segmentation values for the service based on the prioritized set of parameter values. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each user segment. To calculate the threshold segmentation value, the segmentation threshold calculation component **314** calculates a set of averaged parameter values based on the individual sets of parameter values included in each user segment. The segmentation threshold calculation component **314** may then apply weights determined based on the ranking of the parameters to the averaged parameters value, resulting in a set of weighted averaged parameter values. The segmentation threshold calculation component **314** uses the weighed averaged parameter values to then determine threshold segmentation values for segmenting users into the user segments.

FIG. **8** is a flowchart showing a method **800** for segmenting users based on user lifetime value, according to some example embodiments. The method **800** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **800** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **800** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **800** may be deployed on various other hardware configurations and the method **800** is not intended to be limited to the data segmentation system **108**.

At operation **802**, the automated data segmentation component **206** determines a user lifetime value for each user based on a set of parameter values corresponding to the user. The automated data segmentation component **206** may calculate the user lifetime value using any of a variety of algorithms and/or using any of a variety of parameters.

At operation **804**, the automated data segmentation component **206** generates user segments based on the user lifetime values. For example, the users may be segmented into categories indicating whether a user has a high lifetime value, medium lifetime value, or low lifetime value. The user segments may be used for engaging with users, generating analytics, and/or training segmentation models.

FIG. **9** is a flowchart showing a method **900** for segmenting users based on user an interaction history, according to some example embodiments. The method **900** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **900** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **900** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **900** may be deployed on various other hardware configurations and the method **900** is not intended to be limited to the data segmentation system **108**.

At operation **902**, the automated data segmentation component **206** determines an interaction history for each user based on interaction data corresponding to the user. The interaction history may indicate a listing of previous interactions performed by the user, such as visiting retail location, purchasing an item, visiting a website, and the like.

At operation **904**, the automated data segmentation component **206** generates user segments based on the interaction histories. For example, the users may be segmented into categories indicating whether a user is a loyal customer, at-risk customer, or lost customer. As another example, the

users may be segmented into categories indicating whether a user is trend setter or a trend follower. The user segments may be used for engaging with users, generating analytics, and/or training segmentation models.

FIG. **10** is a flowchart showing a method **1000** for data segmentation of items using machine learning, according to some example embodiments. The method **1000** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1000** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1000** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1000** may be deployed on various other hardware configurations and the method **1000** is not intended to be limited to the data segmentation system **108**.

At operation **1002**, the data accessing component **202** accesses interaction data describing historical interactions associated with a se to of times in relation to a service. The data accessing component **202** accesses data from a service provider that provides the service. The service may include the service provider overall or a subset of the services provided by a service provider, such as a particular physical location (e.g., retail store) or channel associated with the service provider (e.g., online).

The accessed data may include any of a variety of types of data provided by the service provider to be segmented by the data segmentation system **108**. The data accessing component **202** may access the data by receiving transmissions from a service provider system **106**. As another example, the data accessing component **202** may periodically query the service provider system **106** for data.

The data accessed from the service provider system **106** may include data collected from various computing devices and locations. For example, the data may include data gathered by cloud-based servers of the service provider system **106** that facilitate a website and/or online service of the service provider. As another example, the data may include data gathered by computing devices included in the service provider system **106** that are implemented at physical locations associated with the service provider, such as point of sale (POS) systems, customer tracking systems, and the like.

The data may include any of a variety of types of data gathered by the service provider. For example, the data may include data describing the service provider's users, individual transactions (purchases, reservations, transfers), and/or any other type of user interactions with the service provider. Other types of interactions include use of the services providers website (e.g., page views, items added to cart, etc.), communications with the service provider's representatives and/or agents (e.g., support representatives, sales agents, etc.), visits to the service provider's physical locations (e.g., store visits), and the like. The data may also include data describing inventory items offered for sale by the service provider. For example, the data may include data identifying the inventory items (e.g., stock keeping unit (SKU) codes), a quantity of the inventory items, the location of the inventory items (e.g., retail store, warehouse, etc.), inventory item type (e.g., pants, shirt, etc.), description of the inventory items (e.g., color, size, etc.), and the like.

The data may be aggregated and/or normalized to describe individual users and/or individual inventory items. For example, data associated with each individual user and/or inventory item may be used to calculate a set of parameter values corresponding to a set of parameters for describing the individual user and/or inventory item. The parameters may include any parameter for describing a user or inventory item. For example, the set of parameters may include parameters that describe a user's interaction history with the service provider, such as an average cart size of the user, a frequency at which the user interacts with the service provider, a purchase history of the user, a recency of the user's latest interaction with the service provider, a user lifetime value (LTV), and the like. The parameters may also include data describing an inventory item, such as an item type, color, size, an average time to sale of the item, an average sale price at which the inventory item was purchased, an average expiration duration of the item, and the like. The parameter values may be calculated by the service provider system **106** prior to transmission of the data to the data segmentation system **108** and/or by the data segmentation system **108**.

At operation **1004**, the training data component **302** generates item segments based on the interaction data. The item segments each include a subset of the items and are used to train a segmentation model. The item segments may be generated based on categorizations determined by human reviewers and/or according to a predetermined set of criteria or rules. The item segments may each represent a predetermined category for segmenting the items.

At operation **1006**, the parameter ranking component **304** prioritizes a set of parameter values based on the interaction data included in each item segment. The parameter ranking component **304** determines a prioritization and/or ranking of various parameters included in the data, such as parameters that describe a user and/or inventory item.

At operation **1008**, the segmentation threshold calculation component **314** determines a set of threshold segmentation values for the service based on the prioritized set of parameter values. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each item segment. To calculate the threshold segmentation value, the segmentation threshold calculation component **314** calculates a set of averaged parameter values based on the individual sets of parameter values included in each item segment. The segmentation threshold calculation component **314** may then apply weights determined based on the ranking of the parameters to the averaged parameters value, resulting in a set of weighted averaged parameter values. The segmentation threshold calculation component **314** uses the weighed averaged parameter values to then determine threshold segmentation values for segmenting items into the item segments.

FIG. **11** is a flowchart showing a **1100** method for segmenting items based on an arrival, according to some example embodiments. The method **1100** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1100** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1100** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1100** may be deployed on various other hardware configurations and the method **1100** is not intended to be limited to the data segmentation system **108**.

At operation **1102**, the automated data segmentation component **206** determines an arrival date for each item based on interaction data associated with the item. The arrival date may indicate a date at which the inventory item was released, arrived at a retail location, was made available for sale, and the like.

At operation **1104**, the automated data segmentation component **206** generates item segments based on the arrival dates. For example, the items may be segmented into categories indicating whether the item is a new item or older item. The item segments may be used for engaging with users, generating recommendations, generating analytics, and/or training segmentation models.

FIG. **12** is a flowchart showing a method **1200** for segmenting items based on estimated purchase times, according to some example embodiments. The method **1200** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1200** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1200** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1200** may be deployed on various other hardware configurations and the method **1200** is not intended to be limited to the data segmentation system **108**.

At operation **1202**, the automated data segmentation component **206** determines an estimated purchase time for each item based on interaction data associated with the item. The estimated purchase time may indicate an estimated amount of time for an item listed for sale to be purchased. The estimated purchase time may be determined based on an average sale time for the item, as determined from the interaction data.

At operation **1204**, the automated data segmentation component **206** generates item segments based on the estimated purchase times. For example, the items may be segmented into categories indicating whether the item is a hot item that is expected to sell quickly or a slow mover. The item segments may be used for engaging with users, generating recommendations, generating analytics, and/or training segmentation models.

FIG. **13** is a flowchart showing a method **1300** for data segmentation of users based on loyalty value using machine learning, according to some example embodiments. The method **1300** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1300** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1300** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1300** may be deployed on various other hardware configurations and the method **1300** is not intended to be limited to the data segmentation system **108**.

At operation **1302**, the data accessing component **202** accesses interaction data describing historical interactions performed by a set of users in relation to a service. The data accessing component **202** accesses data from a service provider that provides the service. The service may include the service provider overall or a subset of the services provided by a service provider, such as a particular physical location (e.g., retail store) or channel associated with the service provider (e.g., online).

The accessed data may include any of a variety of types of data provided by the service provider to be segmented by the data segmentation system **108**. The data accessing component **202** may access the data by receiving transmissions from a service provider system **106**. As another example, the data accessing component **202** may periodically query the service provider system **106** for data.

The data accessed from the service provider system **106** may include data collected from various computing devices and locations. For example, the data may include data gathered by cloud-based servers of the service provider system **106** that facilitate a website and/or online service of the service provider. As another example, the data may include data gathered by computing devices included in the service provider system **106** that are implemented at physical locations associated with the service provider, such as point of sale (POS) systems, customer tracking systems, and the like.

The data may include any of a variety of types of data gathered by the service provider. For example, the data may include data describing the service provider's users, individual transactions (purchases, reservations, transfers), and/or any other type of user interactions with the service provider. Other types of interactions include use of the services providers website (e.g., page views, items added to cart, etc.), communications with the service provider's representatives and/or agents (e.g., support representatives, sales agents, etc.), visits to the service provider's physical locations (e.g., store visits), and the like. The data may also include data describing inventory items offered for sale by the service provider. For example, the data may include data identifying the inventory items (e.g., stock keeping unit (SKU) codes), a quantity of the inventory items, the location of the inventory items (e.g., retail store, warehouse, etc.), inventory item type (e.g., pants, shirt, etc.), description of the inventory items (e.g., color, size, etc.), and the like.

The data may be aggregated and/or normalized to describe individual users and/or individual inventory items. For example, data associated with each individual user and/or inventory item may be used to calculate a set of parameter values corresponding to a set of parameters for describing the individual user and/or inventory item. The parameters may include any parameter for describing a user or inventory item. For example, the set of parameters may include parameters that describe a user's interaction history with the service provider, such as an average cart size of the user, a frequency at which the user interacts with the service provider, a purchase history of the user, a recency of the user's latest interaction with the service provider, a user lifetime value (LTV), and the like. The parameters may also include data describing an inventory item, such as an item type, color, size, an average time to sale of the item, an average sale price at which the inventory item was purchased, an average expiration duration of the item, and the like. The parameter values may be calculated by the service provider system **106** prior to transmission of the data to the data segmentation system **108** and/or by the data segmentation system **108**.

At operation **1304**, the training data component **302** determines a loyalty value for each user based on the interaction data corresponding to the user. The loyalty value may indicate the loyalty level of a user in relation to a service and/or service provider. The loyalty value may be determined based on a variety of parameters and factors, such as a lifetime value, average cart size, average purchase price, frequency value, and the like.

At operation **1306**, the training data component **302** generates user loyalty segments based on the loyalty values. For example, the users may be segmented into loyalty segments indicating whether the user is a loyal customer, at risk customer, lost customer, and the like.

At operation **1308**, the parameter ranking component **304** prioritizes a set of parameters based on the interaction data included in each user loyalty segment. For example, the parameter ranking component **304** may prioritize the set of

parameters included in each user loyalty segment and/or used to determine the loyalty values for the users.

At operation **1310**, the segmentation threshold calculation component **314** determines a set of threshold segmentation values for the service based on the prioritized set of parameters. The threshold segmentation values define an upper and/or lower limit of a segmentation value range associated with each user loyalty segment. To calculate the threshold segmentation value, the segmentation threshold calculation component **314** calculates a set of averaged parameter values based on the individual sets of parameter values included in each user loyalty segment. The segmentation threshold calculation component **314** may then apply weights determined based on the ranking of the parameters to the averaged parameters value, resulting in a set of weighted averaged parameter values. The segmentation threshold calculation component **314** uses the weighed averaged parameter values to then determine threshold segmentation values for segmenting users into the user loyalty segments.

FIG. **14** is a flowchart showing a method for providing personalized promotions based on user segments, according to some example embodiments. The method **1400** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1400** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1400** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1400** may be deployed on various other hardware configurations and the method **1400** is not intended to be limited to the data segmentation system **108**.

At operation **1402**, the engagement management component **210** selects an item to include in a promotional offer. The engagement management component **210** may select the item based on interaction data associated with a service. For example, the engagement management component **210** may select the item based on determining that the item is nearing an expiration data of the item.

At operation **1404**, the engagement management component **210** identifies a first user and a second user to include in the promotional offer. For example, the engagement management component **210** may identify the users based on a determined affinity between the users and the item and/or a determined affinity between segmentation of the users and the item.

At operation **1406**, the engagement management component **210** determines that the first user is included in a first category and the second user is included in a second category. The users may be categorized based on a variety of factors, such as the types of customer, loyalty level of the customers, and the like. In some embodiments, the categorization may indicate the type of shopper that a customer is, such as a trend setter, a value shopper, and the like.

At operation **1408**, the engagement management component **210** generates a first promotional offer for the first user based on the first category and a second promotional offer for the second user based on the second category. The promotional offers generated for the users may be personalized based on the categorization of the user. For example, a user categorized as a trend setter may be provided with a promotion including early access for purchasing an item, whereas a value shopper may be provided with a promotion offering a discounted price for the item. As another example, the size of a discount may be based on the categorization of the users.

At operation **1410**, the engagement management component **210** provides the first promotional offer to the first user and the second promotional offer to the second user.

FIG. **15** is a flowchart showing a method for providing personalized engagement based on configuration parameters, according to some example embodiments. The method **1500** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1500** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1500** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1500** may be deployed on various other hardware configurations and the method **1500** is not intended to be limited to the data segmentation system **108**.

At operation **1502**, the engagement management component **210** determines that a triggering condition defined in a set of configuration parameters has been triggered. A triggering condition is one or more conditions that, if met, causes performance of a specified engagement. For example, the engagement may be transmitting a message and/or promotion to a user, sending a recommendation to a user, and the like.

The triggering conditions may include any type of conditions. For example, a triggering condition may be detecting a change in the segmentation of a user, such as detecting a change in the segmentation of a user a loyal customer to an at-risk customer. As another example, a triggering condition may be based on detecting a change in segmentation of an item, such as an item changing segmentation from a hot item to a slow mover. As another example, a triggering condition may be based on a remaining time until an expiration date of an item, such as an item being within one week of expiring. These are just some examples of triggering conditions and are not meant to be limiting. The configuration parameters may utilize any of a variety of type and combinations of triggering conditions.

At operation **1504**, the engagement management component **210** determines a user based on the set of configuration parameters. The configurations may identify rules for selecting users to received promotions when a triggering condition has been satisfied. In some embodiments, the rules may identify a specific segmentation or segmentations of users to receive an engagement. For example, a rule may identify that users segmented as value shoppers to receive a promotion for an item that is nearing its expiration date. As another example, a rule may identify that users determined to have an affinity for item se receive a promotion for the item when a specified triggering condition is satisfied.

At operation **1506**, the engagement management component **210** generates an engagement message based on the set of configuration parameters. The engagement message may be a message, a promotional offer, an item recommendation, and the like. The set of configuration parameters may define the type of engagement message to transmit when a triggering condition has been satisfied. Further, the set of configuration parameters may define constraints on the engagement message, such as constraints on the types or extent of promotions that may be provided to a user. For example, the promotions may include a maximum discounted amount or percentage that may be offered to a user as a promotion. As another example, the constraints may identify a constraint on a number of users that may receive the promotions.

At operation **1508**, the engagement management component **210** provides the engagement message to the user based

on the set of configuration parameters. For example, the engagement message may be sent as an email, text message, SMS, and the like.

FIG. **16** is a flowchart showing a method for determining that a triggering condition has been satisfied, according to some example embodiments. The method **1600** may be embodied in computer readable instructions for execution by one or more processors such that the operations of the method **1600** may be performed in part or in whole by the data segmentation system **108**; accordingly, the method **1600** is described below by way of example with reference thereto. However, it shall be appreciated that at least some of the operations of the method **1600** may be deployed on various other hardware configurations and the method **1600** is not intended to be limited to the data segmentation system **108**.

At operation **1602**, the engagement management component **210** determines that a segmentation of a user has changed from a first category to a second category. For example, the user's segmentation may have changed from a user a loyal customer to an at-risk customer

At operation **1604**, the engagement management component **210** determines a promotional offer to provide to the user based on the set of configuration parameters. For example, the configuration parameters may define the type of promotion to provide the user and/or the type of promotion to provide based on a segmentation of the user. As an example, a user that is a trend setter may be provided with a recommendation to purchase a newly released item. As another example, a user that is determined to be an at-risk customer may be provided with a promotional offer to in an effort to retain the user and/or turn the user from an at-risk customer into a loyal customer. As another example, a user that is a trend setter may be provided with a promotion to receive early access to a newly released item, whereas a user that is cost conscious may be provided with a promotion offering a discount to purchase the item.

At operation **1606**, the engagement management component **210** provides the promotional offer to the user. For example, the engagement message may be sent as an email, text message, SMS, and the like.

Software Architecture

FIG. **17** is a block diagram illustrating an example software architecture **1706**, which may be used in conjunction with various hardware architectures herein described. FIG. **17** is a non-limiting example of a software architecture **1706** and it will be appreciated that many other architectures may be implemented to facilitate the functionality described herein. The software architecture **1706** may execute on hardware such as machine **1800** of FIG. **18** that includes, among other things, processors **1804**, memory **1814**, and (input/output) I/O components **1818**. A representative hardware layer **1752** is illustrated and can represent, for example, the machine **1800** of FIG. **18**. The representative hardware layer **1752** includes a processing unit **1754** having associated executable instructions **1704**. Executable instructions **1704** represent the executable instructions of the software architecture **1706**, including implementation of the methods, components, and so forth described herein. The hardware layer **1752** also includes memory and/or storage modules **1756**, which also have executable instructions **1704**. The hardware layer **1752** may also comprise other hardware **1758**.

In the example architecture of FIG. **17**, the software architecture **1706** may be conceptualized as a stack of layers where each layer provides particular functionality. For example, the software architecture **1706** may include layers such as an operating system **1702**, libraries **1720**, frameworks/middleware **1718**, applications **1716**, and a presentation layer **1714**. Operationally, the applications **1716** and/or other components within the layers may invoke application programming interface (API) calls **1708** through the software stack and receive a response such as messages **1712** in response to the API calls **1708**. 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 **1718**, while others may provide such a layer. Other software architectures may include additional or different layers.

The operating system **1702** may manage hardware resources and provide common services. The operating system **1702** may include, for example, a kernel **1722**, services **1724**, and drivers **1726**. The kernel **1722** may act as an abstraction layer between the hardware and the other software layers. For example, the kernel **1722** may be responsible for memory management, processor management (e.g., scheduling), component management, networking, security settings, and so on. The services **1724** may provide other common services for the other software layers. The drivers **1726** are responsible for controlling or interfacing with the underlying hardware. For instance, the drivers **1726** 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.

The libraries **1720** provide a common infrastructure that is used by the applications **1716** and/or other components and/or layers. The libraries **1720** provide functionality that allows other software components to perform tasks in an easier fashion than to interface directly with the underlying operating system **1702** functionality (e.g., kernel **1722**, services **1724**, and/or drivers **1726**). The libraries **1720** may include system libraries **1744** (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 **1720** may include API libraries **1746** such as media libraries (e.g., libraries to support presentation and manipulation of various media format such as MPEG4, H.264, MP3, AAC, AMR, JPG, PNG), graphics libraries (e.g., an OpenGL framework that may be used to render 2D and 3D in a 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 **1720** may also include a wide variety of other libraries **1748** to provide many other APIs to the applications **1716** and other software components/modules.

The frameworks/middleware **1718** (also sometimes referred to as middleware) provide a higher-level common infrastructure that may be used by the applications **1716** and/or other software components/modules. For example, the frameworks/middleware **1718** may provide various graphical user interface (GUI) functions, high-level resource management, high-level location services, and so forth. The frameworks/middleware **1718** may provide a broad spectrum of other APIs that may be used by the applications **1716** and/or other software components/modules, some of which may be specific to a particular operating system **1702** or platform.

The applications **1716** include built-in applications **1738** and/or third-party applications **1740**. Examples of representative built-in applications **1738** 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. Third-party applications **1740** 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 **1740** may invoke the API calls **1708** provided by the mobile operating system (such as operating system **1702**) to facilitate functionality described herein.

The applications **1716** may use built in operating system functions (e.g., kernel **1722**, services **1724**, and/or drivers **1726**), libraries **1720**, and frameworks/middleware **1718** to create UIs 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 presentation layer **1714**. In these systems, the application/component "logic" can be separated from the aspects of the application/component that interact with a user.

FIG. **18** is a block diagram illustrating components of a machine **1800**, according to some example embodiments, able to read instructions **1704** 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. **18** shows a diagrammatic representation of the machine **1800** in the example form of a computer system, within which instructions **1810** (e.g., software, a program, an application, an applet, an app, or other executable code) for causing the machine **1800** to perform any one or more of the methodologies discussed herein may be executed. As such, the instructions **1810** may be used to implement modules or components described herein. The instructions **1810** transform the general, non-programmed machine **1800** into a particular machine **1800** programmed to carry out the described and illustrated functions in the manner described. In alternative embodiments, the machine **1800** operates as a standalone device or may be coupled (e.g., networked) to other machines. In a networked deployment, the machine **1800** 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 **1800** may comprise, but not be limited to, a server computer, a client computer, a 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 **1800** capable of executing the instructions **1810**, sequentially or otherwise, that specify actions to be taken by machine **1800**. Further, while only a single machine **1800** is illustrated, the term "machine" shall also be taken to include a collection of machines that individually or jointly execute the instructions **1810** to perform any one or more of the methodologies discussed herein.

The machine **1800** may include processors **1804**, memory/storage **1806**, and I/O components **1818**, which may be configured to communicate with each other such as via a bus **1802**. The memory/storage **1806** may include a memory **1814**, such as a main memory, or other memory storage, and a storage unit **1816**, both accessible to the processors **1804** such as via the bus **1802**. The storage unit **1816** and memory **1814** store the instructions **1810** embodying any one or more of the methodologies or functions described herein. The instructions **1810** may also reside, completely or partially, within the memory **1814**, within the storage unit **1816**, within at least one of the processors **1804** (e.g., within the processor's cache memory), or any suitable combination thereof, during execution thereof by the machine **1800**. Accordingly, the memory **1814**, the storage unit **1816**, and the memory of processors **1804** are examples of machine-readable media.

The I/O components **1818** may include a wide variety of components to receive input, provide output, produce output, transmit information, exchange information, capture measurements, and so on. The specific I/O components **1818** that are included in a particular machine **1800** 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 **1818** may include many other components that are not shown in FIG. **18**. The I/O components **1818** are grouped according to functionality merely for simplifying the following discussion and the grouping is in no way limiting. In various example embodiments, the I/O components **1818** may include output components **1826** and input components **1828**. The output components **1826** 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 **1828** 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 instrument), 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.

In further example embodiments, the I/O components **1818** may include biometric components **1830**, motion components **1834**, environmental components **1836**, or position components **1838** among a wide array of other components. For example, the biometric components **1830** 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 **1834** may include acceleration sensor components (e.g., accelerometer), gravitation sensor components, rotation sensor components (e.g., gyroscope), and so forth. The environmental components **1836** may include, for example, illumination sensor components (e.g., photometer), temperature sensor components (e.g., one or more thermometer 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 **1838** 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.

Communication may be implemented using a wide variety of technologies. The I/O components **1818** may include communication components **1840** operable to couple the machine **1800** to a network **1832** or devices **1820** via coupling **1824** and coupling **1822**, respectively. For example, the communication components **1840** may include a network interface component or other suitable device to interface with the network **1832**. In further examples, communication components **1840** 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 **1820** may be another machine or any of a wide variety of peripheral devices (e.g., a peripheral device coupled via a USB).

Moreover, the communication components **1840** may detect identifiers or include components operable to detect identifiers. For example, the communication components **1840** 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, PDF417, 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 **1840** such as location via Internet Protocol (IP) geo-location, location via Wi-Fi® signal triangulation, location via detecting a NFC beacon signal that may indicate a particular location, and so forth.

Glossary

"CARRIER SIGNAL" in this context refers to any intangible medium that is capable of storing, encoding, or carrying instructions **1810** for execution by the machine **1800**, and includes digital or analog communications signals or other intangible medium to facilitate communication of such instructions **1810**. Instructions **1810** may be transmitted or received over the network **1832** using a transmission medium via a network interface device and using any one of a number of well-known transfer protocols.

"CLIENT DEVICE" in this context refers to any machine **1800** that interfaces to a communications network **1832** to obtain resources from one or more server systems or other client devices **102**, **104**. A client device **102**, **104** may be, but is not limited to, mobile phones, desktop computers, laptops, PDAs, smart phones, tablets, ultra books, netbooks, laptops, multi-processor systems, microprocessor-based or programmable consumer electronics, game consoles, STBs, or any other communication device that a user may use to access a network **1832**.

"COMMUNICATIONS NETWORK" in this context refers to one or more portions of a network **1832** that may be an ad hoc network, an intranet, an extranet, a virtual private network (VPN), a LAN, a wireless LAN (WLAN), a 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, a network **1832** or a portion of a network **1832** may include a wireless or cellular network and the coupling may be a Code Division Multiple Access (CDMA) connection, a Global System for Mobile communications (GSM) connection, or other 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, others defined by various standard setting organizations, other long range protocols, or other data transfer technology.

"MACHINE-READABLE MEDIUM" in this context refers to a component, device or other tangible media able to store instructions **1810** and data temporarily or permanently and may include, but is not be 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., 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 **1810**. The term "machine-readable medium" shall also be taken to include any medium, or combination of multiple media, that is capable of storing instructions **1810** (e.g., code) for execution by a machine **1800**, such that the instructions **1810**, when executed by one or more processors **1804** of the machine **1800**, cause the machine **1800** to perform any one or more of the methodologies described herein. Accordingly, a "machine-readable medium" refers 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 signals per se.

"COMPONENT" in this context refers to a device, physical entity, or logic having boundaries defined by function or subroutine calls, branch points, APIs, 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. 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 example 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 **1804**) may be configured by software (e.g., an application **1716** 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. 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 **1804** or other programmable processor **1804**. Once configured by such software, hardware components become specific machines **1800** (or specific components of a machine **1800**) uniquely tailored to perform the configured functions and are no longer general-purpose processors **1804**. 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. 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 **1804** configured by software to become a special-purpose processor, the general-purpose processor **1804** 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 **1804**, 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 **1802**) 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 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. 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 **1804** that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors **1804** 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 **1804**. Similarly, the methods described herein may be at least partially processor-implemented, with a particular processor or processors **1804** being an example of hardware. For example, at least some of the operations of a method may be performed by one or more processors **1804** or processor-implemented components. Moreover, the one or more processors **1804** 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 **1800** including processors **1804**), with these operations being accessible via a network **1832** (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 **1804**, not only residing within a single machine **1800**, but deployed across a number of machines **1800**. In some example embodiments, the processors **1804** 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 example embodiments, the processors **1804** or processor-implemented components may be distributed across a number of geographic locations.

"PROCESSOR" in this context refers to any circuit or virtual circuit (a physical circuit emulated by logic executing on an actual processor **1804**) that manipulates data values according to control signals (e.g., "commands," "op codes," "machine code," etc.) and which produces corresponding output signals that are applied to operate a machine **1800**. A processor **1804** may be, for example, 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 **1804** may further be a multi-core processor having two or more independent processors **1804** (sometimes referred to as "cores") that may execute instructions **1810** contemporaneously.

What is claimed is:

1. A method comprising:

accessing interaction data describing historical interactions performed by a set of users in relation to a first service, the interaction data including a respective set of parameter values corresponding to each user from the set of users, each respective set of parameter values including one or more individual parameter values for a set of parameters;

generating, based on the interaction data, a first user segment including a first subset of the set of users and a second user segment including a second subset of the set of users;

prioritizing the set of parameters based on the interaction data and membership of the set of users in the first user segment and the second user segment, yielding a prioritized set of parameters for the first service;

determining a set of threshold segmentation values for the first service based on the respective set of parameter

values corresponding to each user from the set of users and the prioritized set of parameters for the first service;

accessing a first set of parameter values corresponding to a first user that is not included in the set of users;

calculating a first segmentation value based on the first set of parameter values and the prioritized set of parameters for the first service; and

categorizing the first user into a first category based on the first segmentation value and the set of threshold segmentation values for the first service.

2. The method of claim **1**, further comprising:

calculating a second segmentation value based on the first set of parameter values and a second prioritized set of parameters for a second service; and

categorizing the first user into a second category based on the second segmentation value and a set of threshold segmentation values for the second service.

3. The method of claim **1**, wherein determining the first user segment and the second user segment comprises:

determining a user lifetime value (LTV) for each respective user based on the respective set of parameter values corresponding to the respective user, yielding a set of user LTVs; and

generating the first user segment and the second user segment based on the set of user LTVs.

4. The method of claim **1**, wherein determining the first user segment and the second user segment comprises:

determining an interaction history for each respective user based on the interaction data, yielding a set of interaction histories, the interaction history for each respective user indicating times at which the respective user interacted with the first service; and

generating the first user segment and the second user segment based on the set of interaction histories.

5. The method of claim **1**, wherein determining the set of threshold segmentation values for the first service comprises:

determining, based on the respective set of parameter values corresponding to the first subset of the set of users in the first user segment, a first set of averaged parameter values corresponding to the set of parameters;

determining, based on the respective set of parameter values corresponding to the second subset of the set of users in the second user segment, a second set of averaged parameter values corresponding to the set of parameters;

applying weights to the first set of averaged parameter values and the second set of averaged parameter values based on the prioritized set of parameters for the first service, yielding a first set of weighted averaged parameter values and a second set of weighted averaged parameter values;

determining a first threshold segmentation value based on the first set of weighted averaged parameter values; and

determining a second threshold segmentation value based on the second set of weighted averaged parameter values.

6. The method of claim **5**, wherein prioritizing the set of parameters comprises:

performing a linear regression based on sets of parameter values included in the first user segment and the second user segment, yielding a set of signal strength scores for the set of parameters; and

ranking the set of parameters based on the set of signal strength scores.

7. A system comprising:

one or more computer processors; and

one or more computer-readable mediums storing instructions that, when executed by the one or more computer processors, cause the system to perform operations comprising:

accessing interaction data describing historical interactions performed by a set of users in relation to a first service, the interaction data including a respective set of parameter values corresponding to each user from the set of users, each respective set of parameter values including one or more individual parameter values for a set of parameters;

generating, based on the interaction data, a first user segment including a first subset of the set of users and a second user segment including a second subset of the set of users;

prioritizing the set of parameters based on the interaction data and membership of the set of users in the first user segment and the second user segment, yielding a prioritized set of parameters for the first service;

determining a set of threshold segmentation values for the first service based on the respective set of parameter values corresponding to each user from the set of users and the prioritized set of parameters for the first service;

accessing a first set of parameter values corresponding to a first user that is not included in the set of users;

calculating a first segmentation value based on the first set of parameter values and the prioritized set of parameters for the first service; and

categorizing the first user into a first category based on the first segmentation value and the set of threshold segmentation values for the first service.

8. The system of claim **7**, the operations further comprising:

calculating a second segmentation value based on the first set of parameter values and a second prioritized set of parameters for a second service; and

categorizing the first user into a second category based on the second segmentation value and a set of threshold segmentation values for the second service.

9. The system of claim **7**, wherein determining the first user segment and the second user segment comprises:

determining a user lifetime value (LTV) for each respective user based on the respective set of parameter values corresponding to the respective user, yielding a set of user LTVs; and

generating the first user segment and the second user segment based on the set of user LTVs.

10. The system of claim **7**, wherein determining the first user segment and the second user segment comprises:

determining an interaction history for each respective user based on the interaction data, yielding a set of interaction histories, the interaction history for each respective user indicating times at which the respective user interacted with the first service; and

generating the first user segment and the second user segment based on the set of interaction histories.

11. The system of claim **7**, wherein determining the set of threshold segmentation values for the first service comprises:

determining, based on the respective set of parameter values corresponding to the first subset of the set of users in the first user segment, a first set of averaged parameter values corresponding to the set of parameters;

determining, based on the respective set of parameter values corresponding to the second subset of the set of users in the second user segment, a second set of averaged parameter values corresponding to the set of parameters;

applying weights to the first set of averaged parameter values and the second set of averaged parameter values based on the prioritized set of parameters for the first service, yielding a first set of weighted averaged parameter values and a second set of weighted averaged parameter values;

determining a first threshold segmentation value based on the first set of weighted averaged parameter values; and

determining a second threshold segmentation value based on the second set of weighted averaged parameter values.

12. The system of claim **11**, wherein prioritizing the set of parameters comprises:

performing a linear regression based on sets of parameter values included in the first user segment and the second user segment, yielding a set of signal strength scores for the set of parameters; and

ranking the set of parameters based on the set of signal strength scores.

13. A non-transitory computer-readable medium storing instructions that, when executed by one or more computer processors of one or more computing devices, cause the one or more computing devices to perform operations comprising:

accessing interaction data describing historical interactions performed by a set of users in relation to a first service, the interaction data including a respective set of parameter values corresponding to each user from the set of users, each respective set of parameter values including one or more individual parameter values for a set of parameters;

generating, based on the interaction data, a first user segment including a first subset of the set of users and a second user segment including a second subset of the set of users;

prioritizing the set of parameters based on the interaction data and membership of the set of users in the first user segment and the second user segment, yielding a prioritized set of parameters for the first service;

determining a set of threshold segmentation values for the first service based on the respective set of parameter values corresponding to each user from the set of users and the prioritized set of parameters for the first service;

accessing a first set of parameter values corresponding to a first user that is not included in the set of users;

calculating a first segmentation value based on the first set of parameter values and the prioritized set of parameters for the first service; and

categorizing the first user into a first category based on the first segmentation value and the set of threshold segmentation values for the first service.

14. The non-transitory computer-readable medium of claim **13**, the operations further comprising:

calculating a second segmentation value based on the first set of parameter values and a second prioritized set of parameters for a second service; and

categorizing the first user into a second category based on the second segmentation value and a set of threshold segmentation values for the second service.

15. The non-transitory computer-readable medium of claim **13**, wherein determining the first user segment and the second user segment comprises:

determining a user lifetime value (LTV) for each respective user based on the respective set of parameter values corresponding to the respective user, yielding a set of user LTVs; and

generating the first user segment and the second user segment based on the set of user LTVs.

16. The non-transitory computer-readable medium of claim **13**, wherein determining the first user segment and the second user segment comprises:

determining an interaction history for each respective user based on the interaction data, yielding a set of interaction histories, the interaction history for each respective user indicating times at which the respective user interacted with the first service; and

generating the first user segment and the second user segment based on the set of interaction histories.

17. The non-transitory computer-readable medium of claim **13**, wherein determining the set of threshold segmentation values for the first service comprises:

determining, based on the respective set of parameter values corresponding to the first subset of the set of users in the first user segment, a first set of averaged parameter values corresponding to the set of parameters;

determining, based on the respective set of parameter values corresponding to the second subset of the set of users in the second user segment, a second set of averaged parameter values corresponding to the set of parameters;

applying weights to the first set of averaged parameter values and the second set of averaged parameter values based on the prioritized set of parameters for the first service, yielding a first set of weighted averaged parameter values and a second set of weighted averaged parameter values;

determining a first threshold segmentation value based on the first set of weighted averaged parameter values; and

determining a second threshold segmentation value based on the second set of weighted averaged parameter values.

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