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HSU et al.

(54) **ORDERING SEMANTIC QUERY FORMULATION SUGGESTIONS**

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(73) Assignee: **MICROSOFT CORPORATION**, Redmond, WA (US)

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Publication Classification

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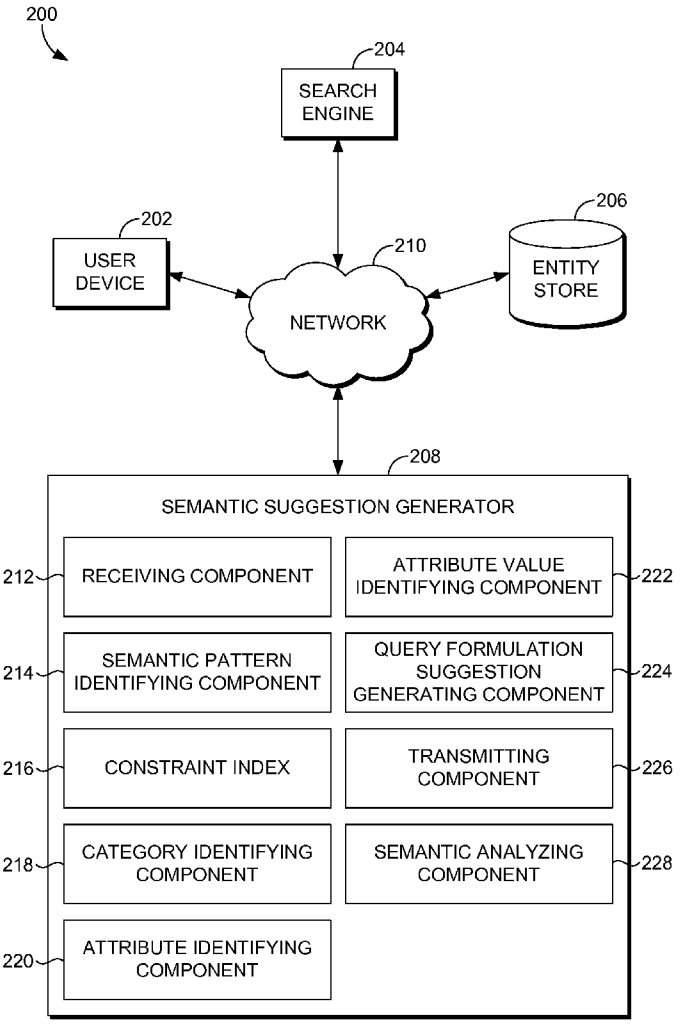
G06F 17/30 (2006.01)

(52) **U.S. Cl.** **707/771**; 707/E17.014

(57) **ABSTRACT**

Methods are provided for ordering semantically-identified query formulation suggestions. Semantic query patterns are identified for a plurality of search queries and a weight is identified for each. Also identified is a plurality of semantic categories, each having an identified weight. Terms/phrases commonly associated with the semantic categories are identified, as are semantic attributes as they pertain to the semantic categories. Semantic attribute patterns and respective weights therefore are identified. A text-parser is generated from the semantic query patterns and respective weights, the semantic category terms, and the semantic attribute patterns and respective weights, the text-parser for use in parsing input user queries or portions thereof. Upon receiving a user search query, the text-parser is applied to determine at least one likely attribute, attribute value, or term commonly associated with a semantic category, and the determined attribute/attribute value/term is transmitted for presentation with an order representative of the respective calculated weights.



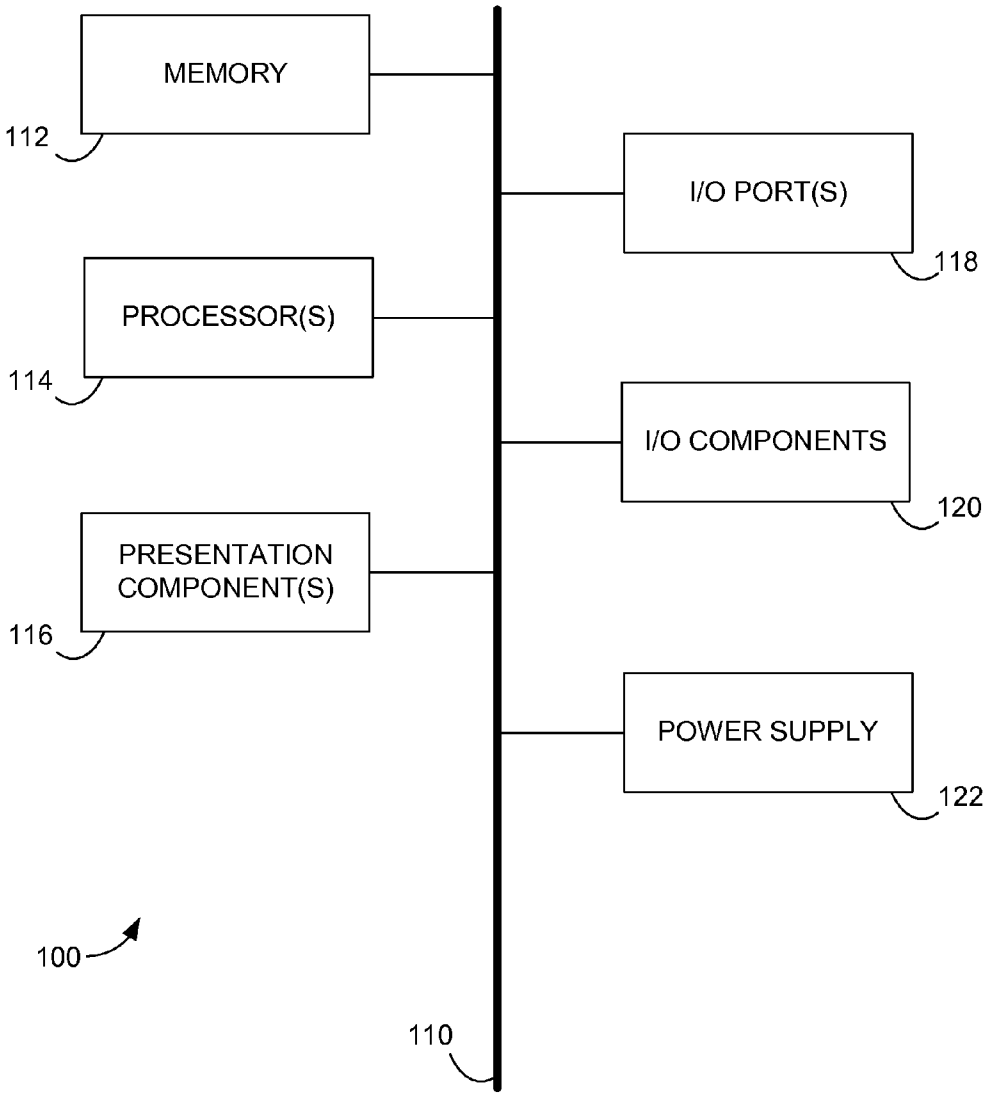

MEMORY
112
PROCESSOR(S)
114
PRESENTATION COMPONENT(S)
116
I/O PORT(S)
118
I/O COMPONENTS
120
POWER SUPPLY
122
100
110

FIG. 1

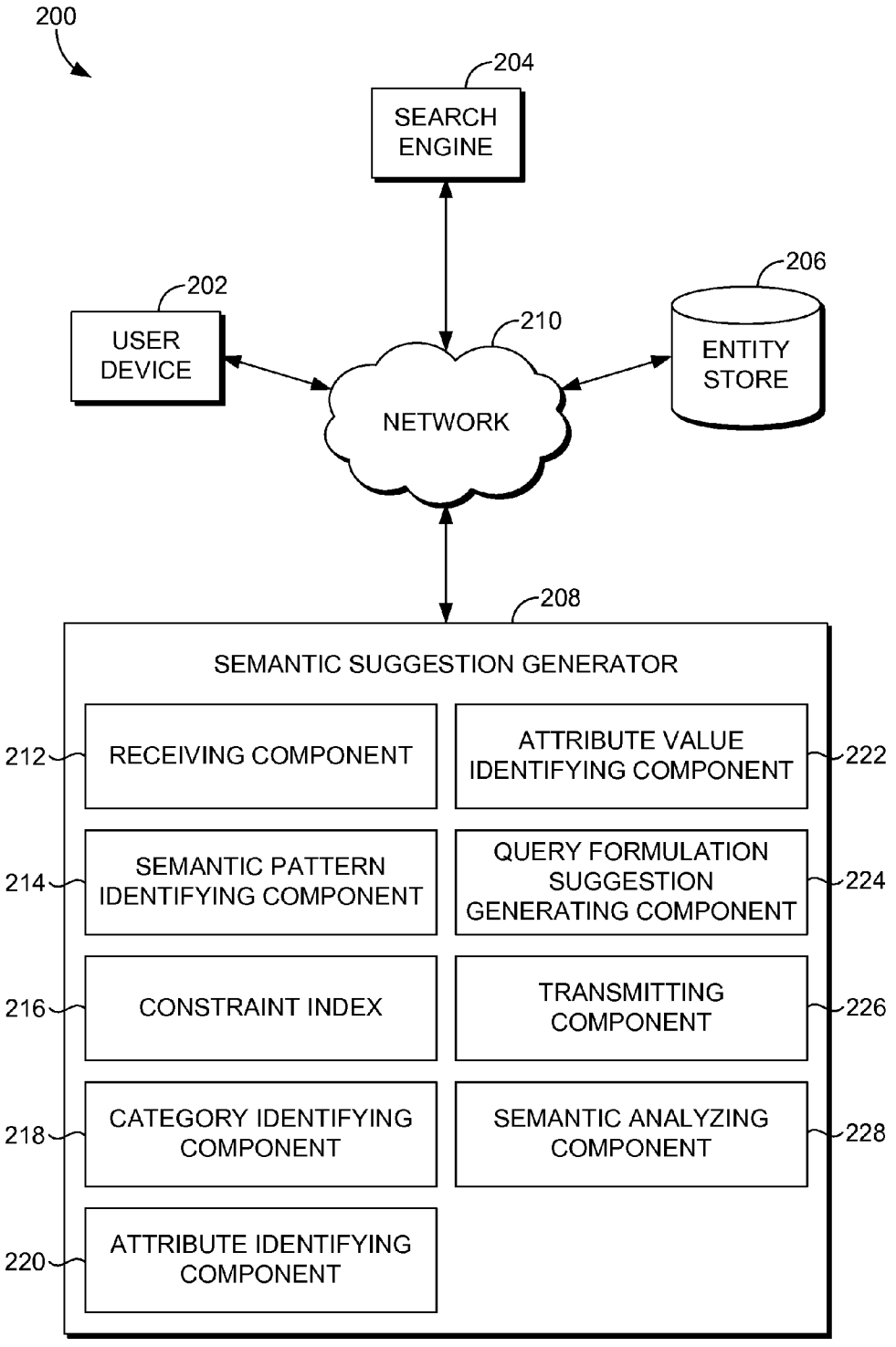
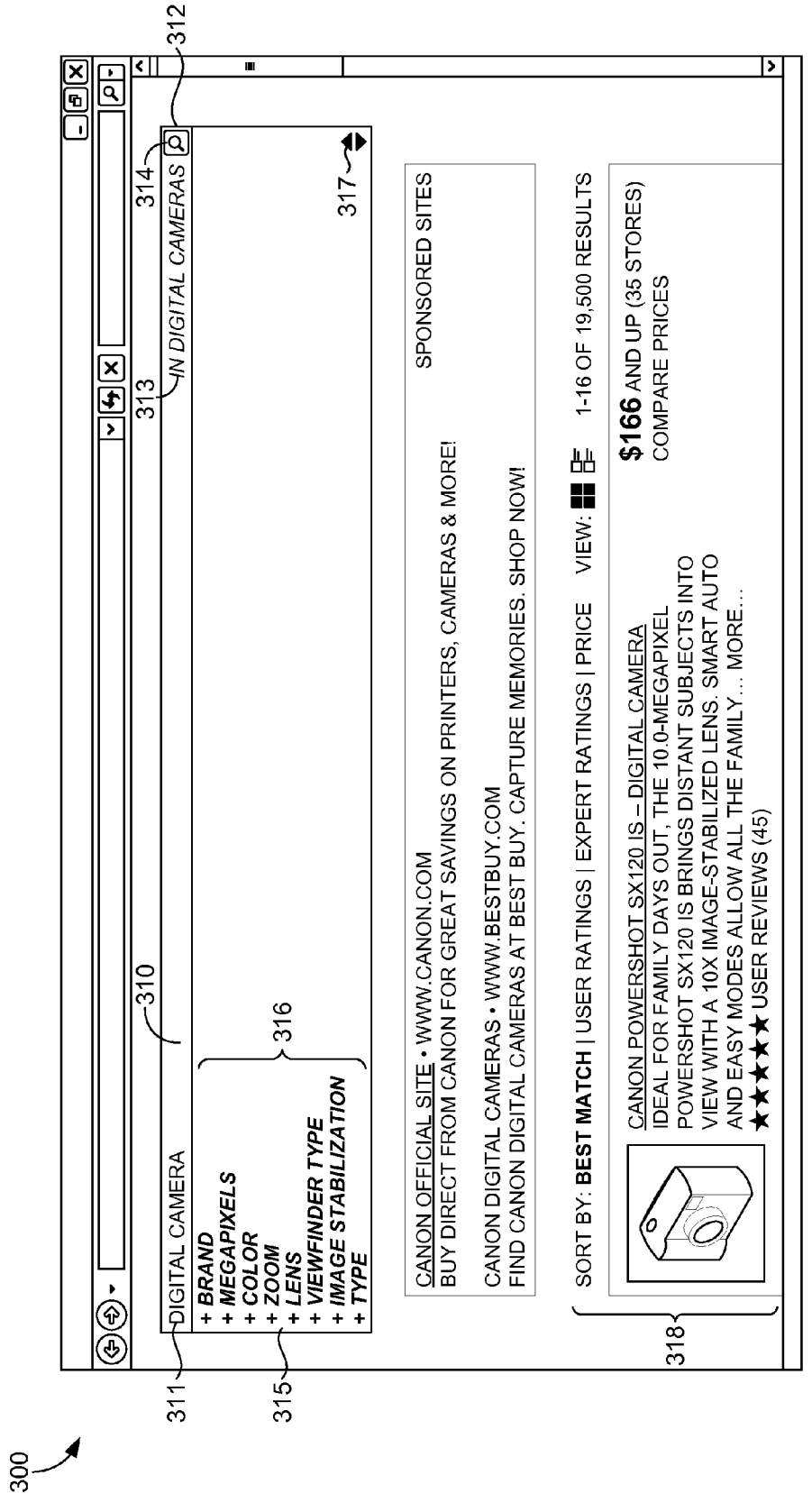

200
204
SEARCH ENGINE
202
USER DEVICE
210
NETWORK
206
ENTITY STORE
208
SEMANTIC SUGGESTION GENERATOR
212
RECEIVING COMPONENT
ATTRIBUTE VALUE IDENTIFYING COMPONENT
222
214
SEMANTIC PATTERN IDENTIFYING COMPONENT
QUERY FORMULATION SUGGESTION GENERATING COMPONENT
224
216
CONSTRAINT INDEX
TRANSMITTING COMPONENT
226
218
CATEGORY IDENTIFYING COMPONENT
SEMANTIC ANALYZING COMPONENT
228
220
ATTRIBUTE IDENTIFYING COMPONENT

FIG. 2


300
311
315
316
310
313
314
312
317
318
DIGITAL CAMERA
+ BRAND
+ MEGAPIXELS
+ COLOR
+ ZOOM
+ LENS
+ VIEWFINDER TYPE
+ IMAGE STABILIZATION
+ TYPE
IN DIGITAL CAMERAS
SPONSORED SITES
CANON OFFICIAL SITE • WWW.CANON.COM
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CANON DIGITAL CAMERAS • WWW.BESTBUY.COM
FIND CANON DIGITAL CAMERAS AT BEST BUY. CAPTURE MEMORIES. SHOP NOW!
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE VIEW: 1-16 OF 19,500 RESULTS
CANON POWERSHOT SX120 IS – DIGITAL CAMERA
IDEAL FOR FAMILY DAYS OUT, THE 10.0-MEGAPIXEL
POWERSHOT SX120 IS BRINGS DISTANT SUBJECTS INTO
VIEW WITH A 10X IMAGE-STABILIZED LENS. SMART AUTO
AND EASY MODES ALLOW ALL THE FAMILY... MORE...
★★★★★ USER REVIEWS (45)
$166 AND UP (35 STORES)
COMPARE PRICES

FIG. 3

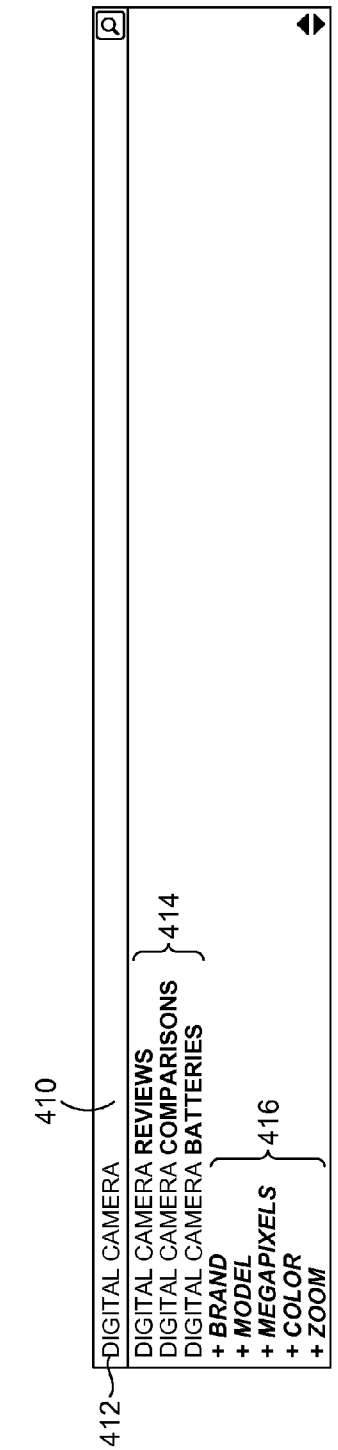

400
410
412
DIGITAL CAMERA
DIGITAL CAMERA REVIEWS
DIGITAL CAMERA COMPARISONS
DIGITAL CAMERA BATTERIES
+ BRAND
+ MODEL
+ MEGAPIXELS
+ COLOR
+ ZOOM
414
416

FIG. 4

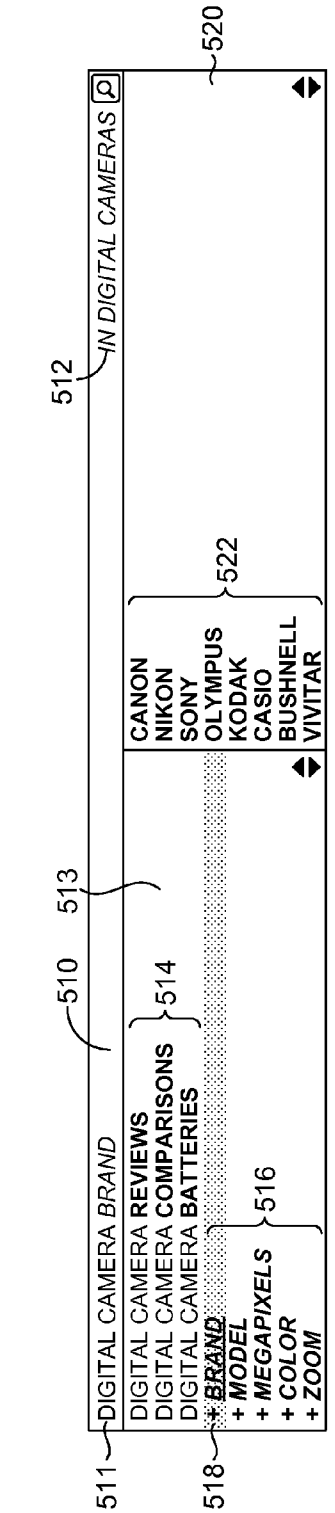

500
511
512
IN DIGITAL CAMERAS
520
DIGITAL CAMERA BRAND
DIGITAL CAMERA REVIEWS
DIGITAL CAMERA COMPARISONS
DIGITAL CAMERA BATTERIES
+ BRAND
+ MODEL
+ MEGAPIXELS
+ COLOR
+ ZOOM
510
513
514
516
518
CANON
NIKON
SONY
OLYMPUS
KODAK
CASIO
BUSHNELL
VIVITAR
522

FIG. 5

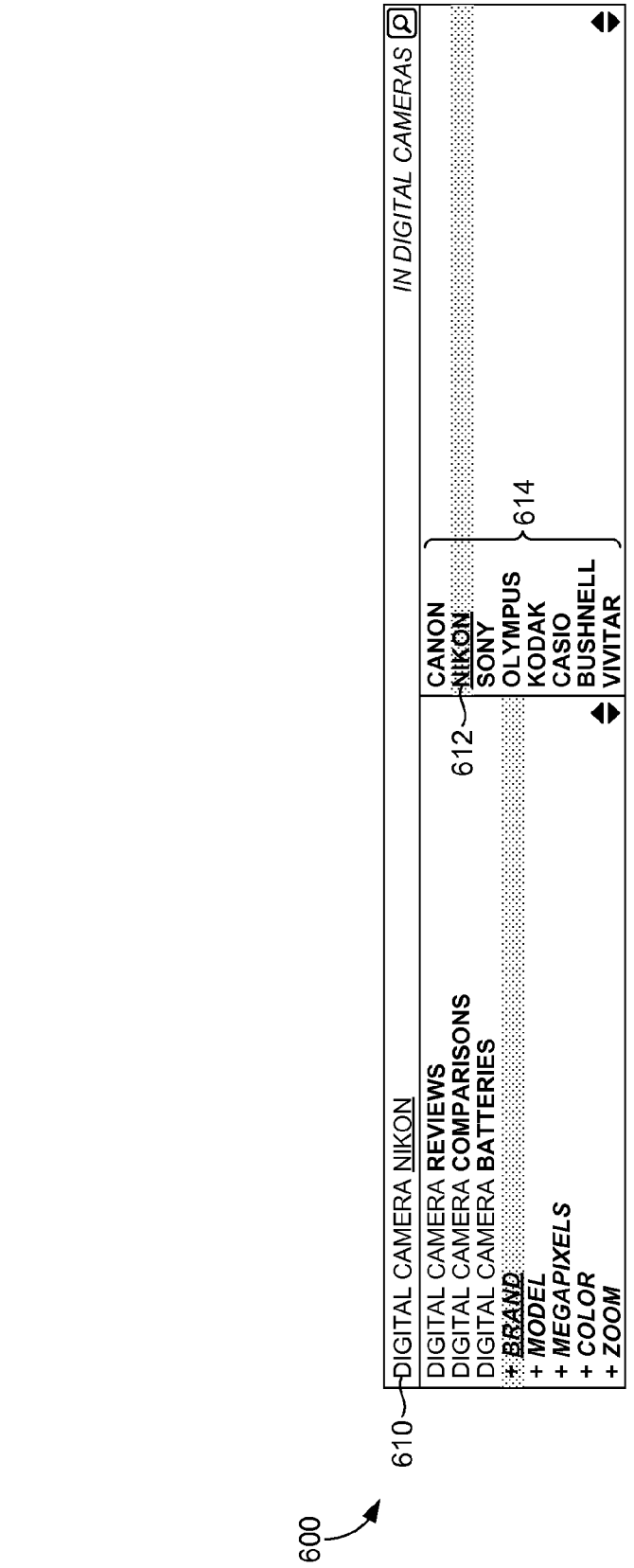

600
610
DIGITAL CAMERA NIKON
IN DIGITAL CAMERAS
DIGITAL CAMERA REVIEWS
DIGITAL CAMERA COMPARISONS
DIGITAL CAMERA BATTERIES
+ BRAND
+ MODEL
+ MEGAPIXELS
+ COLOR
+ ZOOM
612
CANON
NIKON
SONY
OLYMPUS
KODAK
CASIO
BUSHNELL
VIVITAR
614

FIG. 6

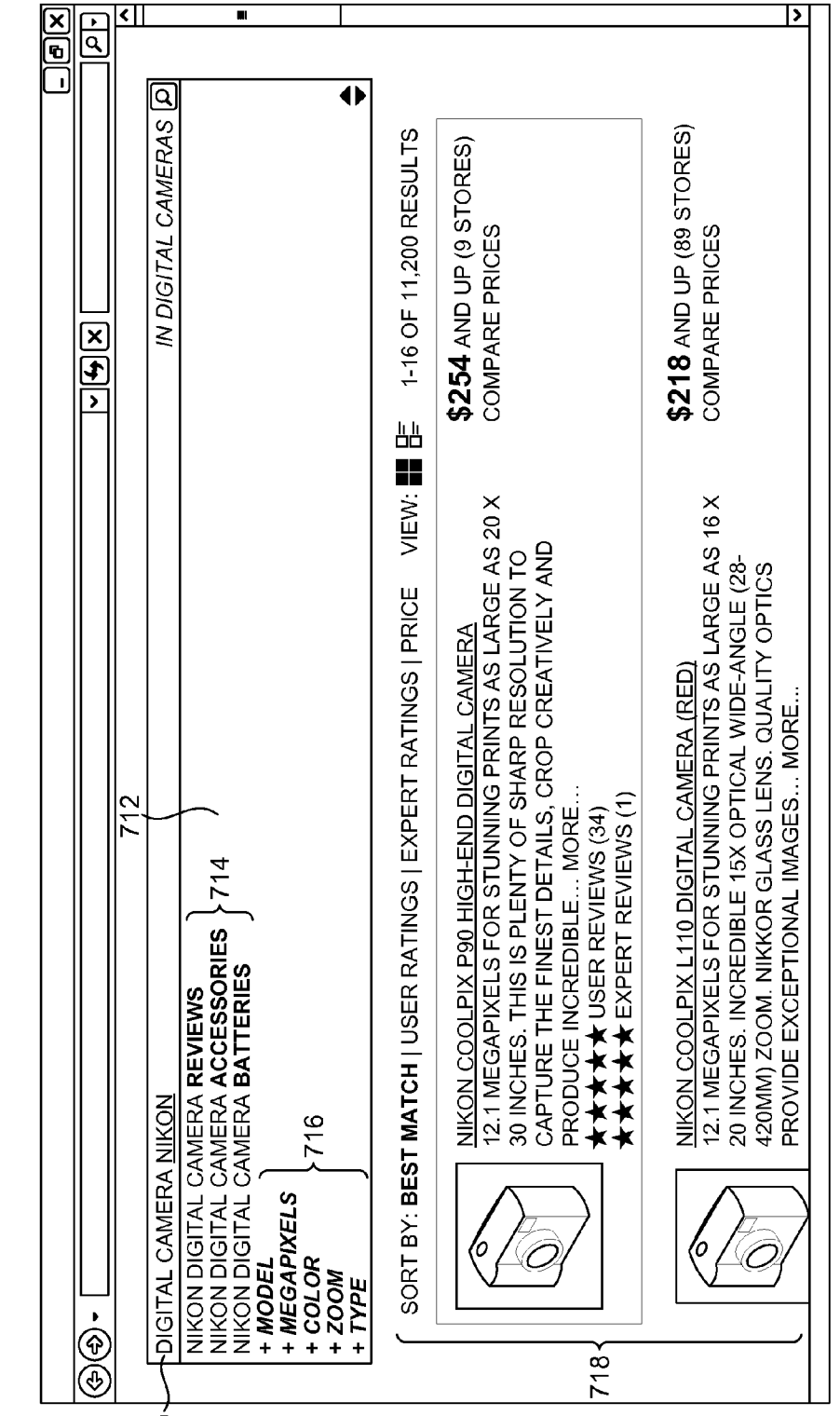
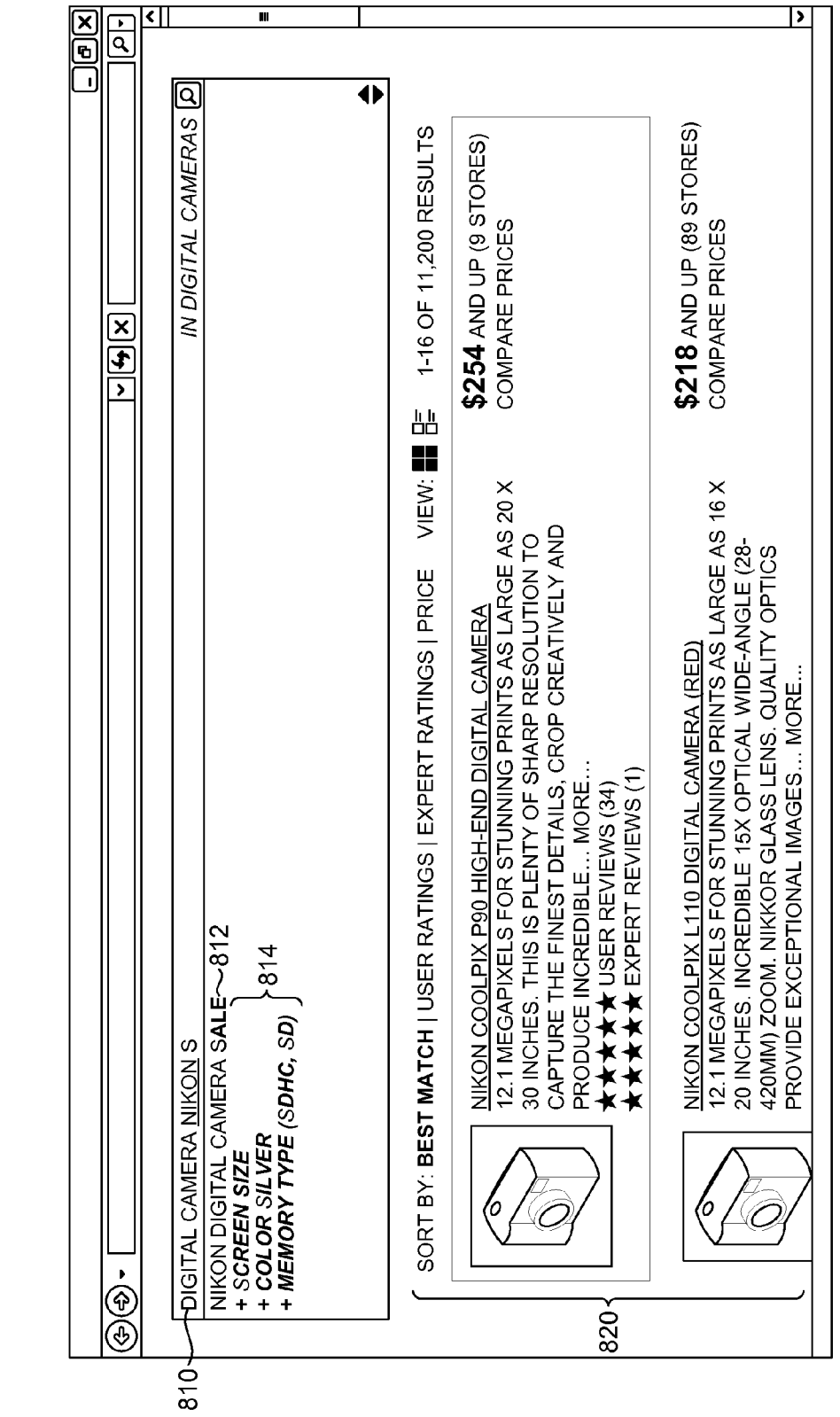

700
710
712
714
716
718
DIGITAL CAMERA NIKON
IN DIGITAL CAMERAS
NIKON DIGITAL CAMERA REVIEWS
NIKON DIGITAL CAMERA ACCESSORIES
NIKON DIGITAL CAMERA BATTERIES
+ MODEL
+ MEGAPIXELS
+ COLOR
+ ZOOM
+ TYPE
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE
VIEW:
1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
12.1 MEGAPIXELS FOR STUNNING PRINTS AS LARGE AS 20 X 30 INCHES. THIS IS PLENTY OF SHARP RESOLUTION TO CAPTURE THE FINEST DETAILS, CROP CREATIVELY AND PRODUCE INCREDIBLE... MORE...
★★★★★ USER REVIEWS (34)
★★★★★ EXPERT REVIEWS (1)
$254 AND UP (9 STORES)
COMPARE PRICES
NIKON COOLPIX L110 DIGITAL CAMERA (RED)
12.1 MEGAPIXELS FOR STUNNING PRINTS AS LARGE AS 16 X 20 INCHES. INCREDIBLE 15X OPTICAL WIDE-ANGLE (28-420MM) ZOOM. NIKKOR GLASS LENS. QUALITY OPTICS PROVIDE EXCEPTIONAL IMAGES... MORE...
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 7


800
810
DIGITAL CAMERA NIKON S
NIKON DIGITAL CAMERA SALE
+ SCREEN SIZE
+ COLOR SILVER
+ MEMORY TYPE (SDHC, SD)
812
814
IN DIGITAL CAMERAS
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE VIEW:
1-16 OF 11,200 RESULTS
820
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
12.1 MEGAPIXELS FOR STUNNING PRINTS AS LARGE AS 20 X 30 INCHES. THIS IS PLENTY OF SHARP RESOLUTION TO CAPTURE THE FINEST DETAILS, CROP CREATIVELY AND PRODUCE INCREDIBLE... MORE...
★★★★★ USER REVIEWS (34)
★★★★★ EXPERT REVIEWS (1)
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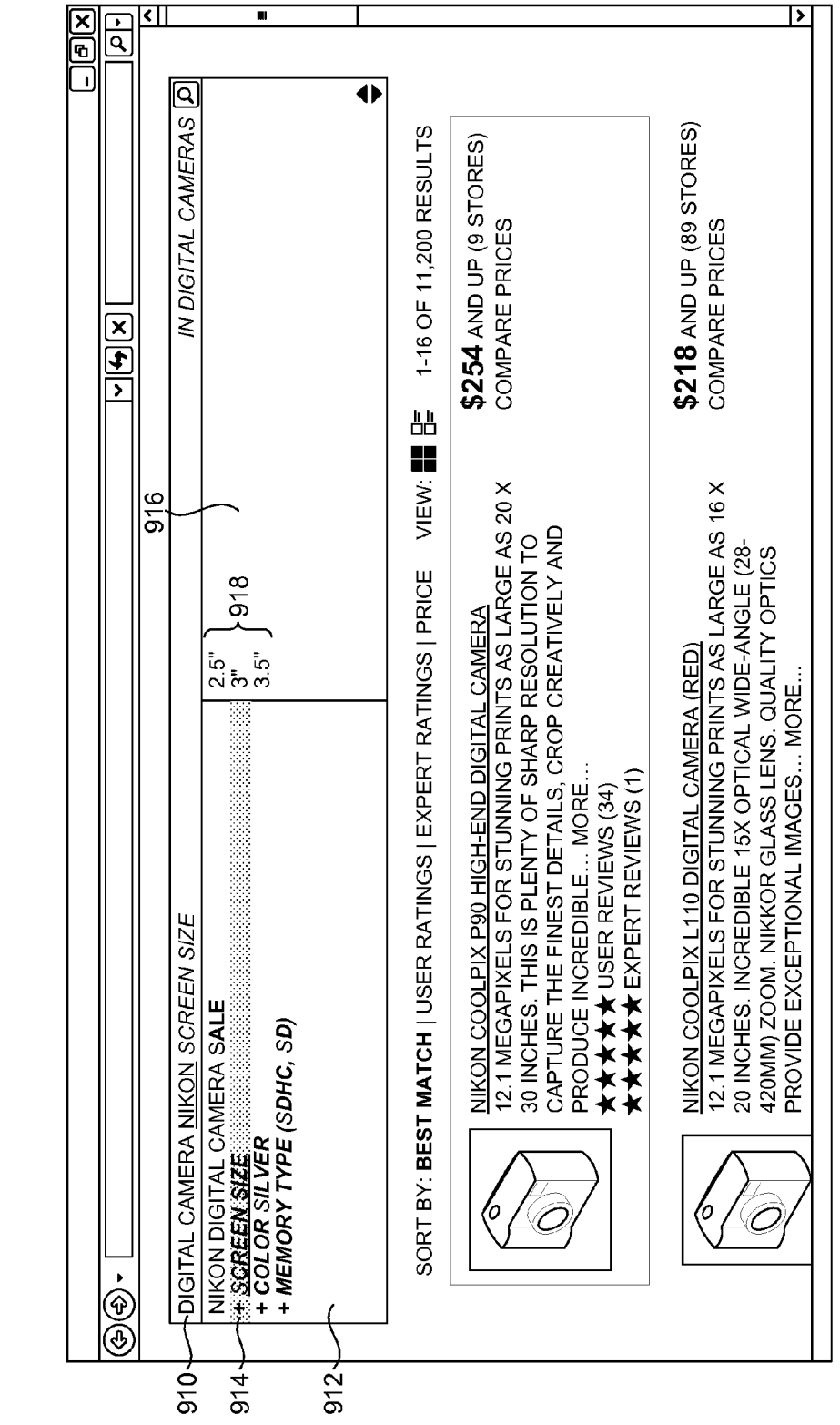
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 8


900
910
914
912
916
918
DIGITAL CAMERA NIKON SCREEN SIZE
NIKON DIGITAL CAMERA SALE
+ SCREEN SIZE
+ COLOR SILVER
+ MEMORY TYPE (SDHC, SD)
2.5"
3"
3.5"
IN DIGITAL CAMERAS
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE VIEW: 1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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★★★★★ USER REVIEWS (34)
★★★★★ EXPERT REVIEWS (1)
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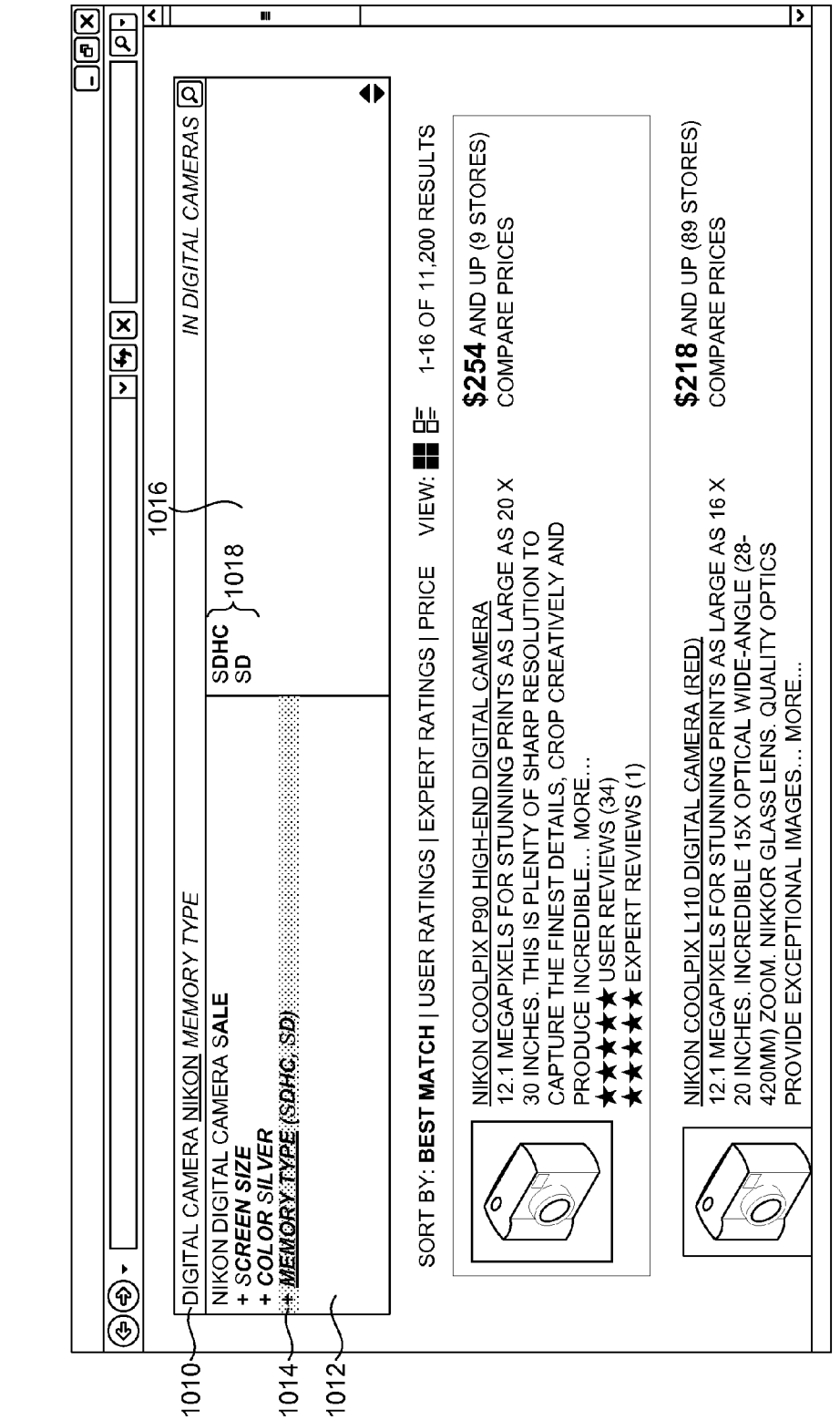
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 9


1000
1010
1014
1012
1016
1018
DIGITAL CAMERA NIKON MEMORY TYPE
NIKON DIGITAL CAMERA SALE
+ SCREEN SIZE
+ COLOR SILVER
+ MEMORY TYPE (SDHC, SD)
SDHC
SD
IN DIGITAL CAMERAS
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE
VIEW:
1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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★★★★½ USER REVIEWS (34)
★★★★★ EXPERT REVIEWS (1)
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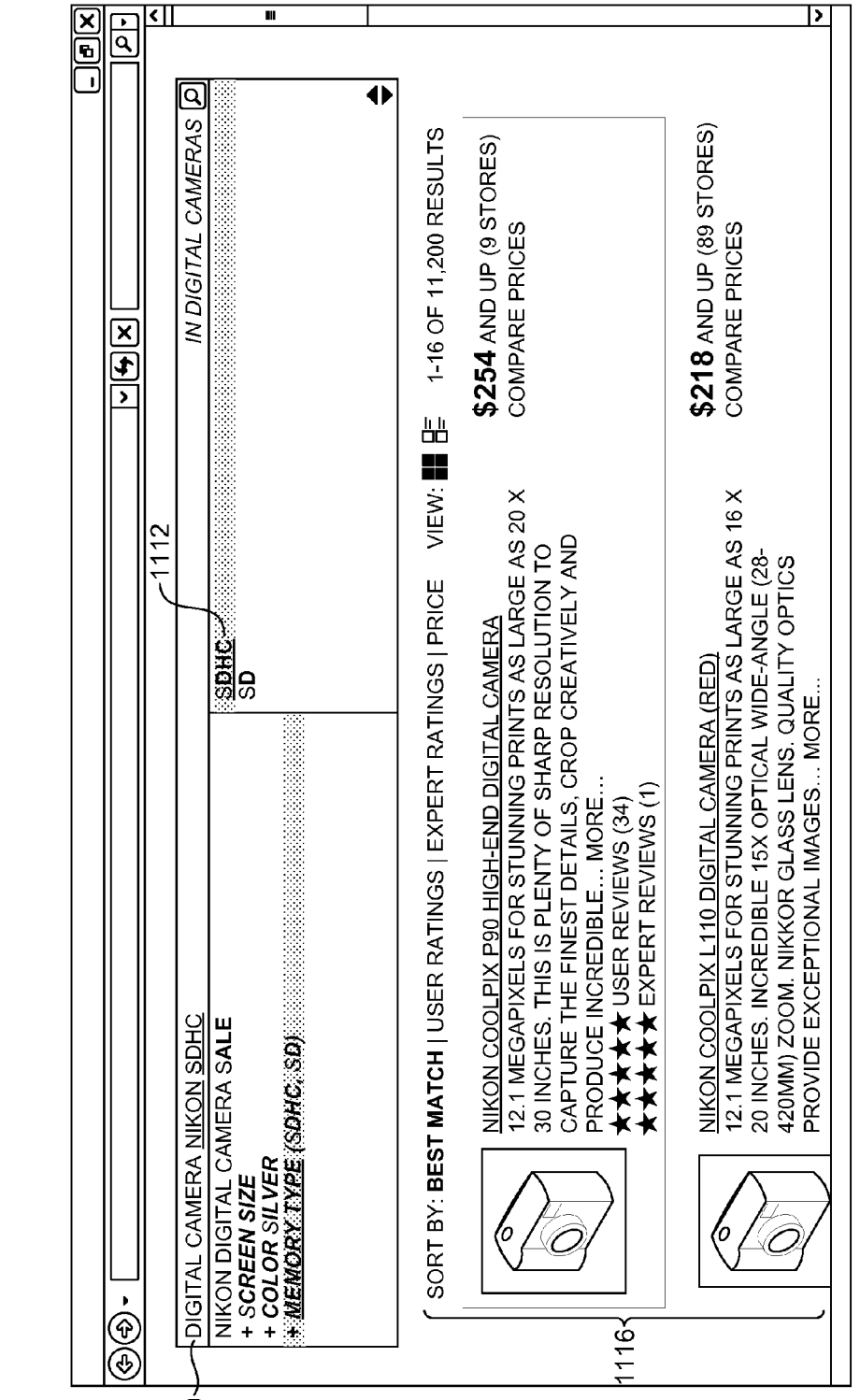
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 10


1100
1110
DIGITAL CAMERA NIKON SDHC
IN DIGITAL CAMERAS
1112
NIKON DIGITAL CAMERA SALE
+ SCREEN SIZE
+ COLOR SILVER
+ MEMORY TYPE (SDHC, SD)
SDHC
SD
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE
VIEW:
1-16 OF 11,200 RESULTS
1116
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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★★★★★ USER REVIEWS (34)
★★★★★ EXPERT REVIEWS (1)
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COMPARE PRICES
NIKON COOLPIX L110 DIGITAL CAMERA (RED)
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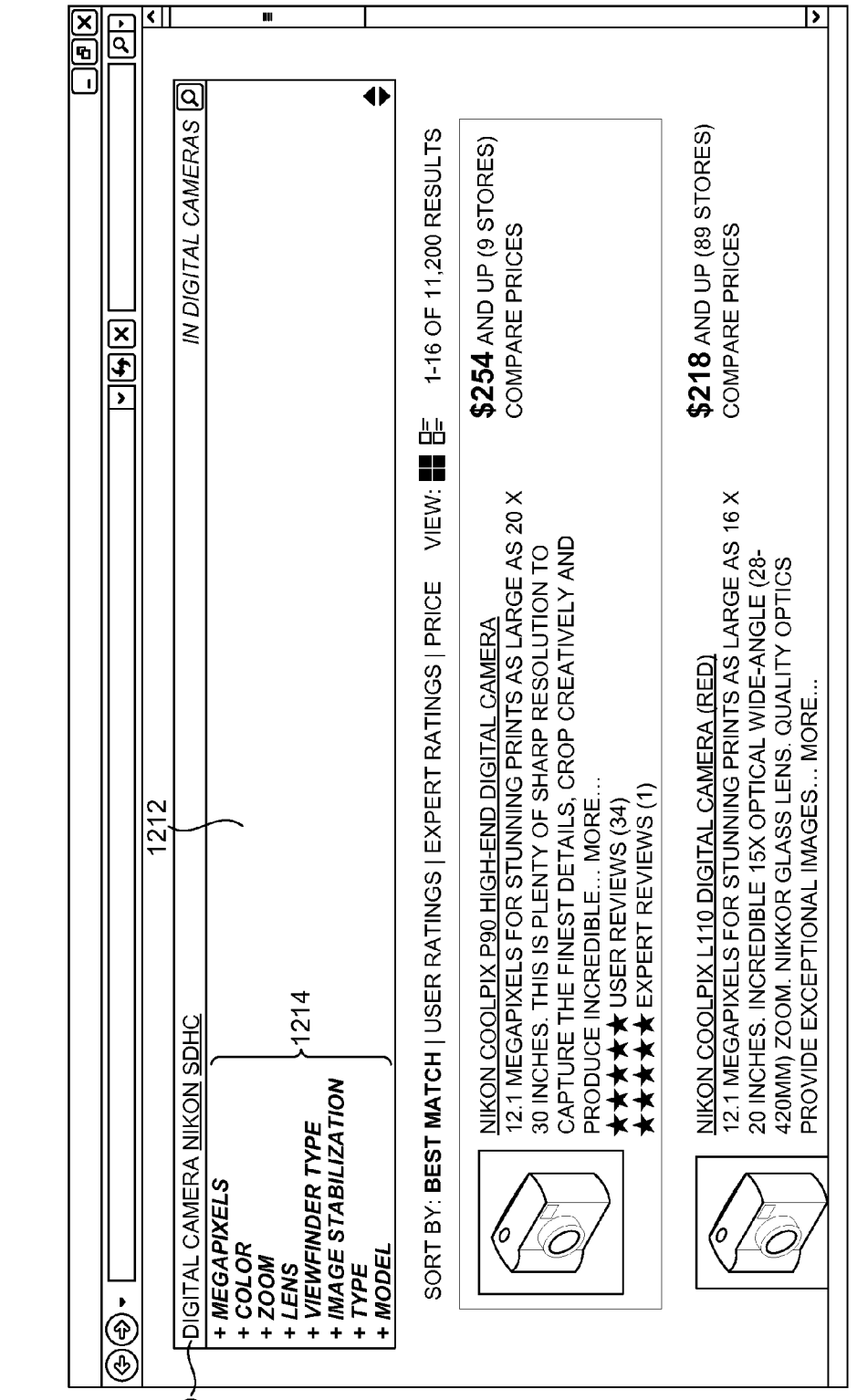
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 11


1200
1210
DIGITAL CAMERA NIKON SDHC
IN DIGITAL CAMERAS
1212
+ MEGAPIXELS
+ COLOR
+ ZOOM
+ LENS
+ VIEWFINDER TYPE
+ IMAGE STABILIZATION
+ TYPE
+ MODEL
1214
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE VIEW: 1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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★★★★★ EXPERT REVIEWS (1)
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COMPARE PRICES
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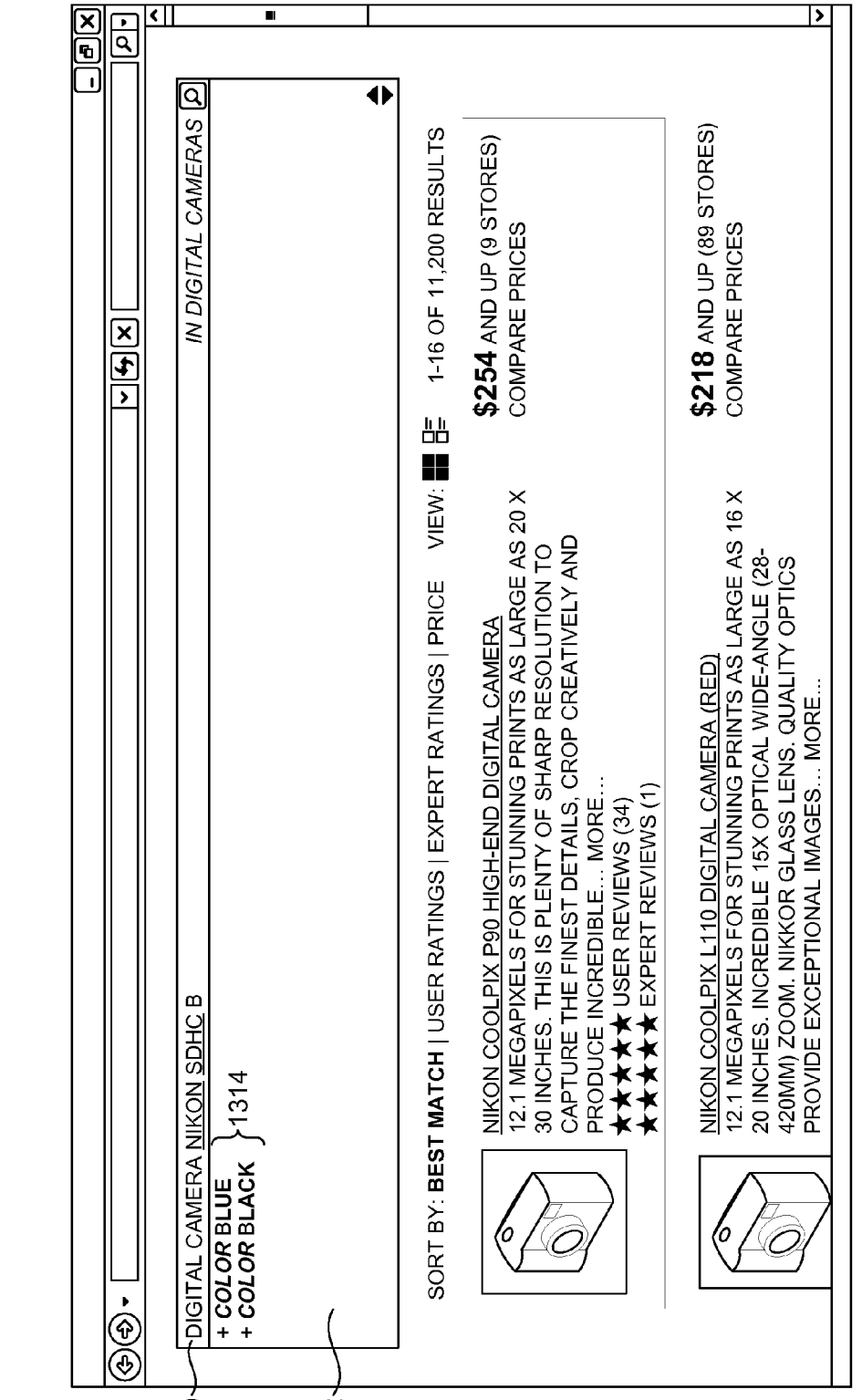
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 12


1300
1310
1312
1314
DIGITAL CAMERA NIKON SDHC B
+ COLOR BLUE
+ COLOR BLACK
IN DIGITAL CAMERAS
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE
VIEW:
1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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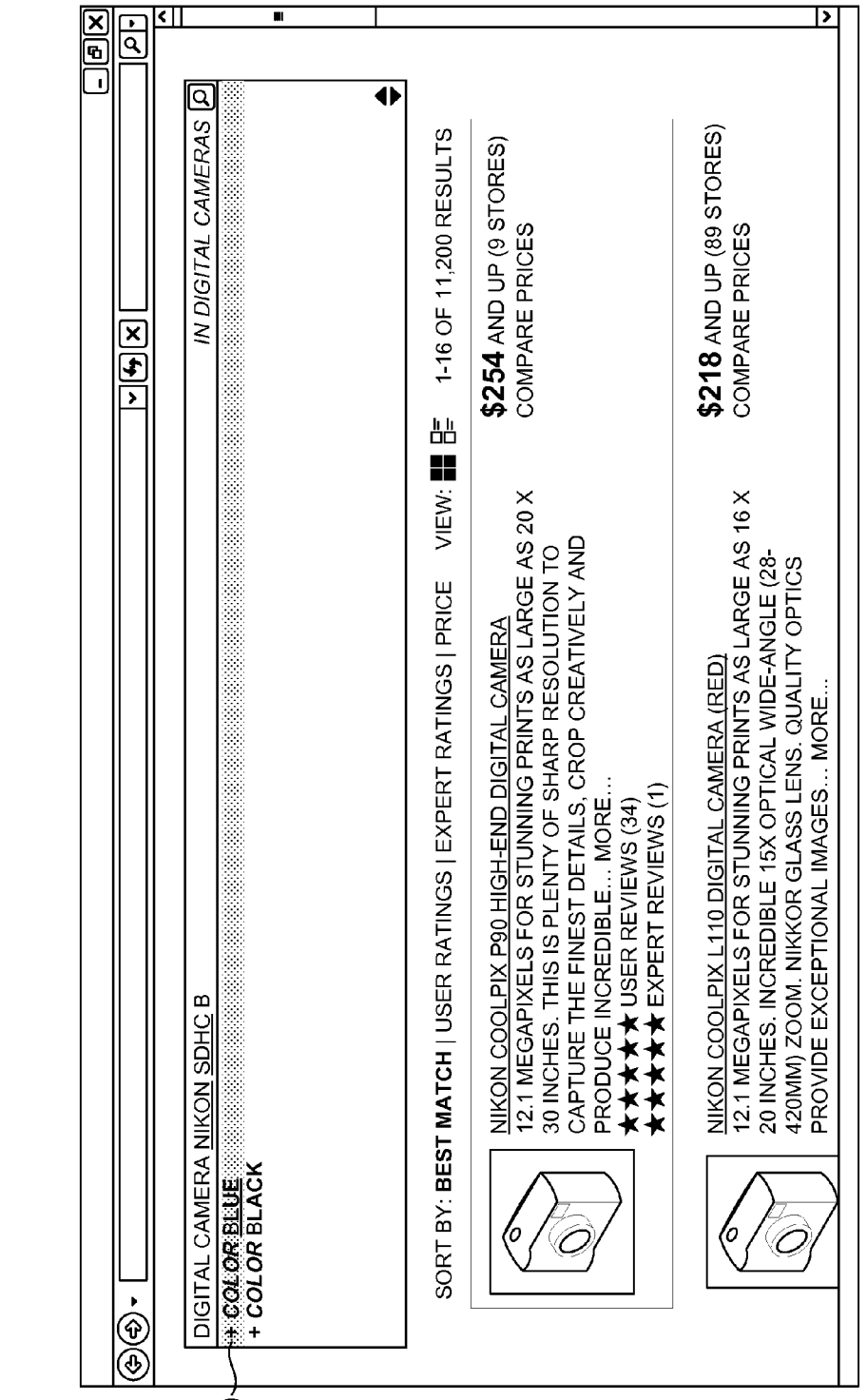
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 13


1400
1410
DIGITAL CAMERA NIKON SDHC B
IN DIGITAL CAMERAS
+ COLOR BLUE
+ COLOR BLACK
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE VIEW: 1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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★★★★★ EXPERT REVIEWS (1)
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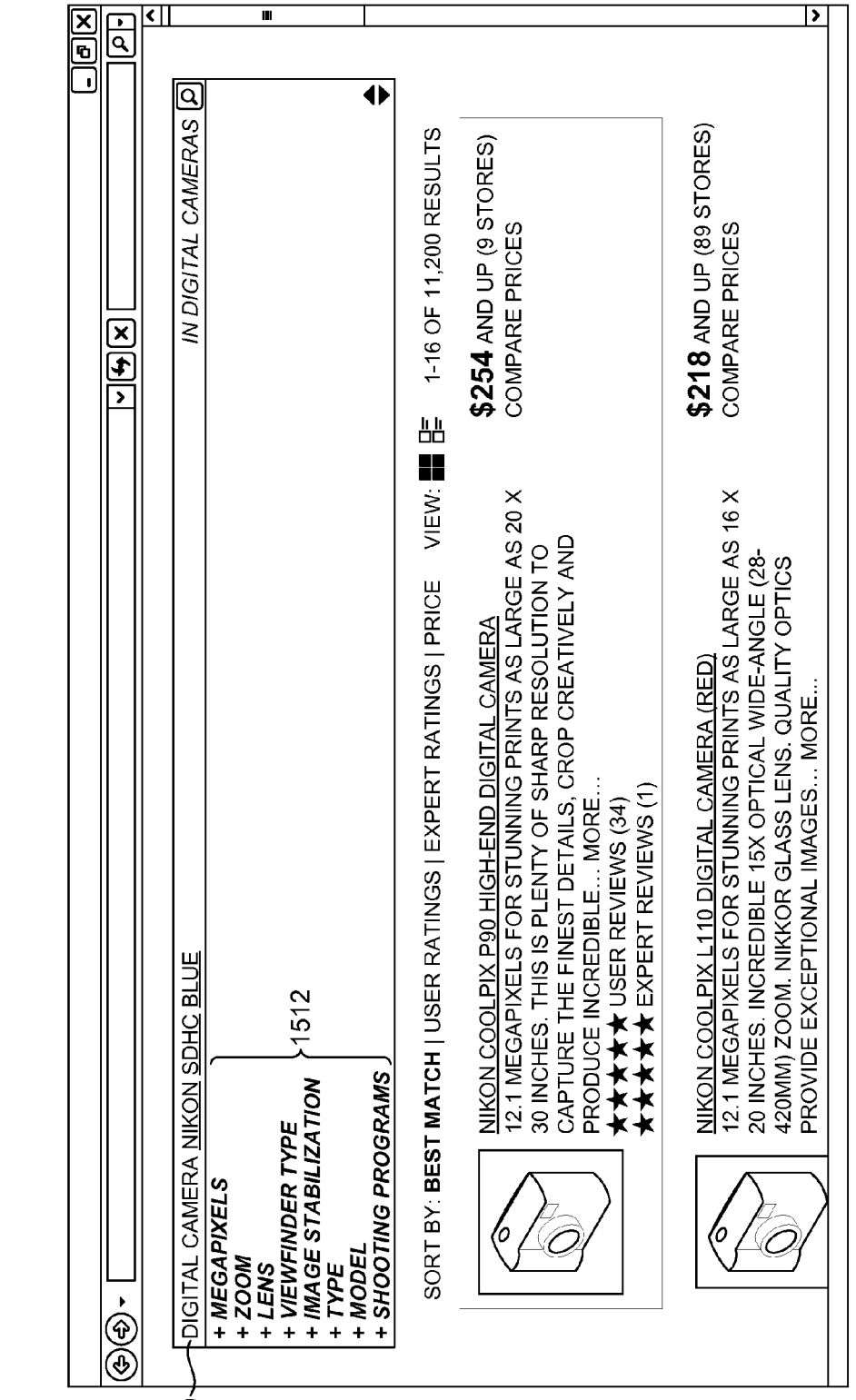
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 14


1500
1510
DIGITAL CAMERA NIKON SDHC BLUE
IN DIGITAL CAMERAS
+ MEGAPIXELS
+ ZOOM
+ LENS
+ VIEWFINDER TYPE
+ IMAGE STABILIZATION
+ TYPE
+ MODEL
+ SHOOTING PROGRAMS
1512
SORT BY: BEST MATCH | USER RATINGS | EXPERT RATINGS | PRICE
VIEW:
1-16 OF 11,200 RESULTS
NIKON COOLPIX P90 HIGH-END DIGITAL CAMERA
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★★★★★ EXPERT REVIEWS (1)
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COMPARE PRICES
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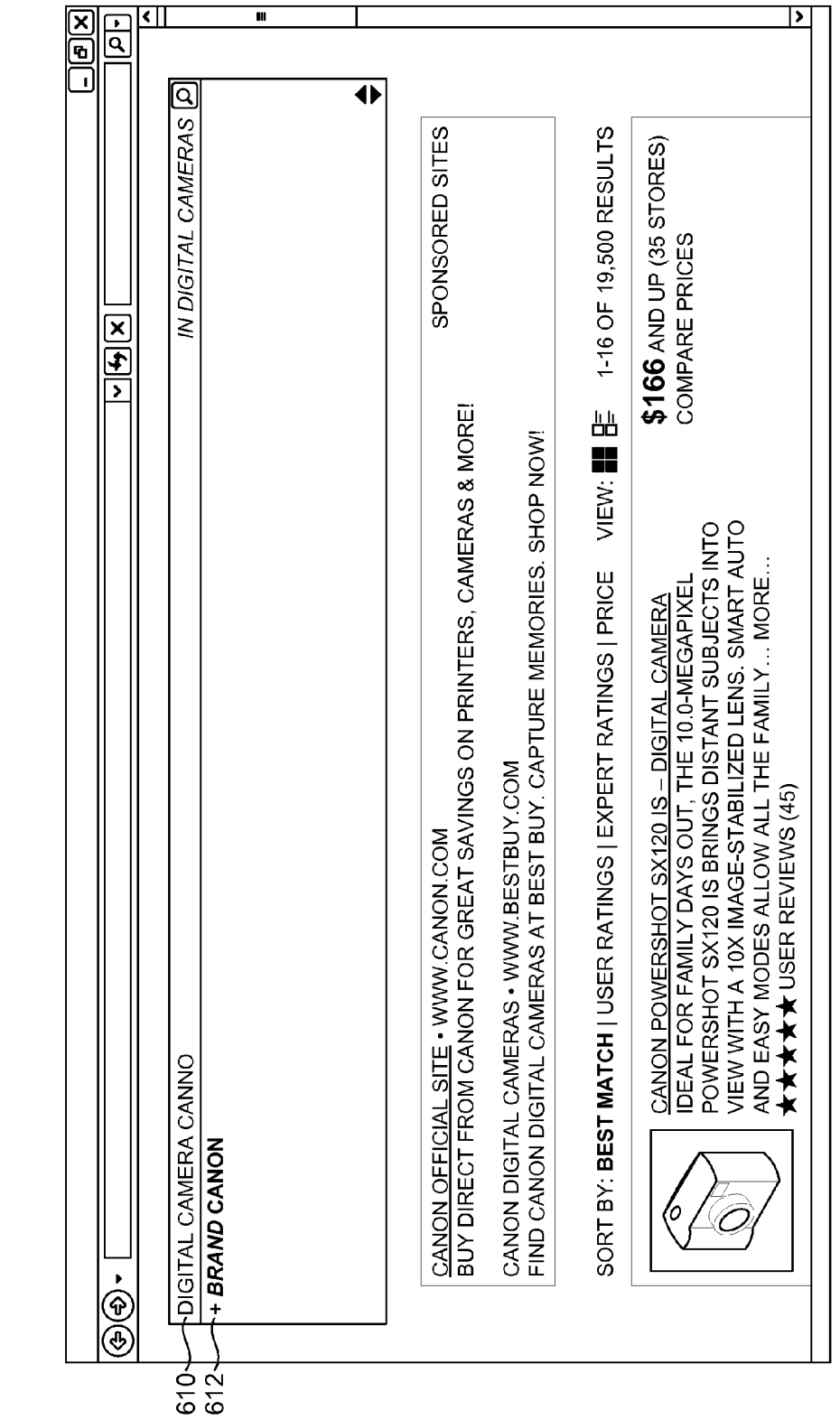
$218 AND UP (89 STORES)
COMPARE PRICES

FIG. 15


1600
1610
1612
DIGITAL CAMERA CANNO
IN DIGITAL CAMERAS
+ BRAND CANON
SPONSORED SITES
CANON OFFICIAL SITE • WWW.CANON.COM
BUY DIRECT FROM CANON FOR GREAT SAVINGS ON PRINTERS, CAMERAS & MORE!
CANON DIGITAL CAMERAS • WWW.BESTBUY.COM
FIND CANON DIGITAL CAMERAS AT BEST BUY. CAPTURE MEMORIES. SHOP NOW!
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★★★★★ USER REVIEWS (45)
$166 AND UP (35 STORES)
COMPARE PRICES

FIG. 16

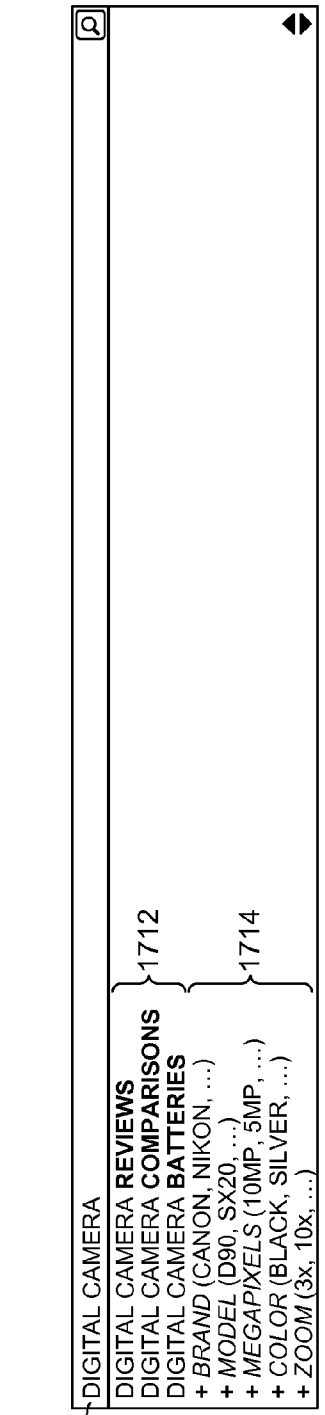
1700
1710
DIGITAL CAMERA
DIGITAL CAMERA REVIEWS
DIGITAL CAMERA COMPARISONS
DIGITAL CAMERA BATTERIES
+ BRAND (CANON, NIKON, ...)
+ MODEL (D90, SX20, ...)
+ MEGAPIXELS (10MP, 5MP, ...)
+ COLOR (BLACK, SILVER, ...)
+ ZOOM (3x, 10x, ...)
1712
1714

FIG. 17

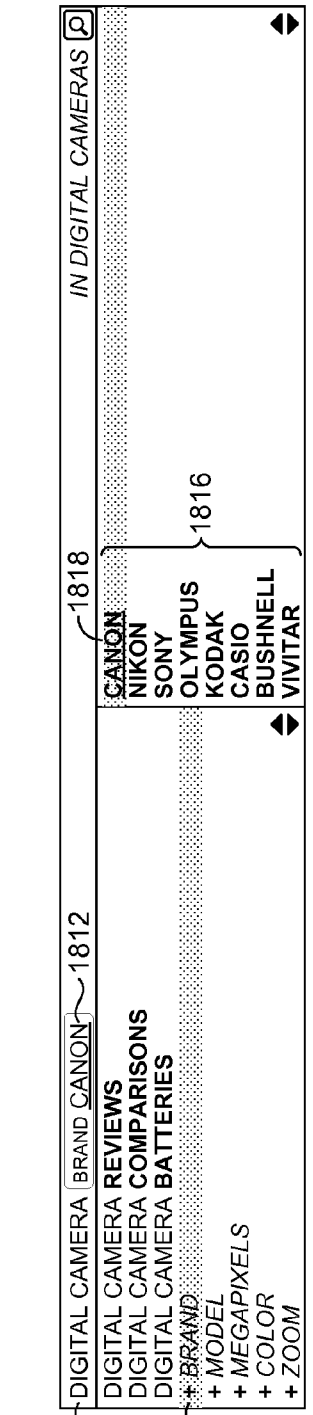
1800
1810
DIGITAL CAMERA BRAND CANON
IN DIGITAL CAMERAS
1812
1814
DIGITAL CAMERA REVIEWS
DIGITAL CAMERA COMPARISONS
DIGITAL CAMERA BATTERIES
+ BRAND
+ MODEL
+ MEGAPIXELS
+ COLOR
+ ZOOM
1818
CANON
NIKON
SONY
OLYMPUS
KODAK
CASIO
BUSHNELL
VIVITAR
1816

FIG. 18

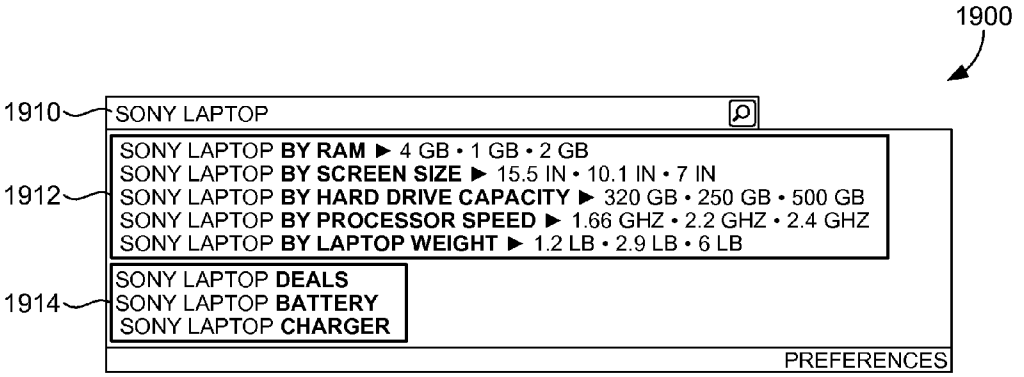
1900
1910
SONY LAPTOP
1912
SONY LAPTOP BY RAM ▶ 4 GB • 1 GB • 2 GB
SONY LAPTOP BY SCREEN SIZE ▶ 15.5 IN • 10.1 IN • 7 IN
SONY LAPTOP BY HARD DRIVE CAPACITY ▶ 320 GB • 250 GB • 500 GB
SONY LAPTOP BY PROCESSOR SPEED ▶ 1.66 GHZ • 2.2 GHZ • 2.4 GHZ
SONY LAPTOP BY LAPTOP WEIGHT ▶ 1.2 LB • 2.9 LB • 6 LB
1914
SONY LAPTOP DEALS
SONY LAPTOP BATTERY
SONY LAPTOP CHARGER
PREFERENCES

FIG. 19

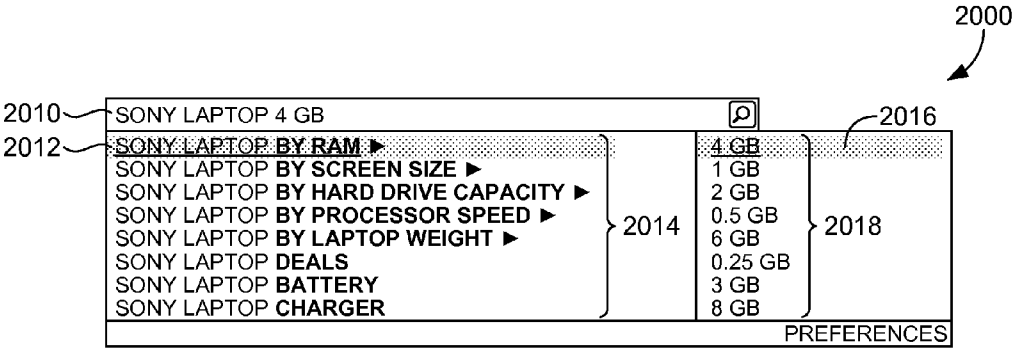
2000
2010
SONY LAPTOP 4 GB
2012
SONY LAPTOP BY RAM ▶
SONY LAPTOP BY SCREEN SIZE ▶
SONY LAPTOP BY HARD DRIVE CAPACITY ▶
SONY LAPTOP BY PROCESSOR SPEED ▶
SONY LAPTOP BY LAPTOP WEIGHT ▶
SONY LAPTOP DEALS
SONY LAPTOP BATTERY
SONY LAPTOP CHARGER
2014
2016
4 GB
1 GB
2 GB
0.5 GB
6 GB
0.25 GB
3 GB
8 GB
2018
PREFERENCES

FIG. 20

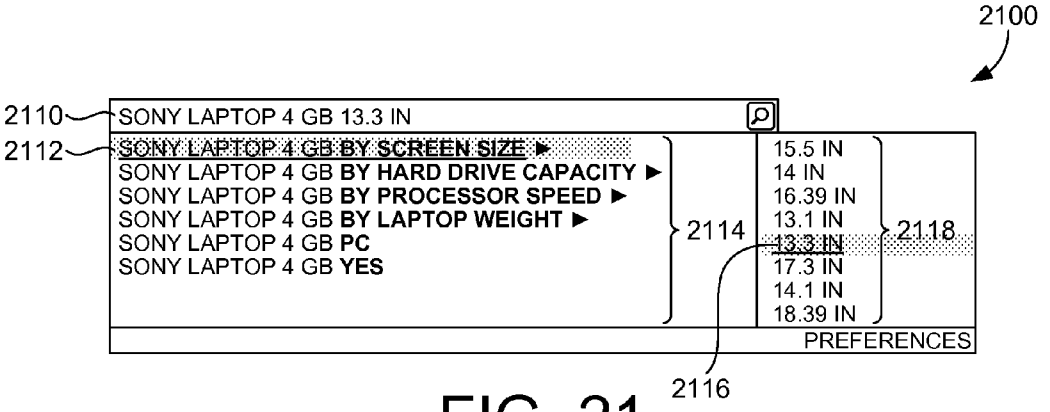
2100
2110
SONY LAPTOP 4 GB 13.3 IN
2112
SONY LAPTOP 4 GB BY SCREEN SIZE ▶
SONY LAPTOP 4 GB BY HARD DRIVE CAPACITY ▶
SONY LAPTOP 4 GB BY PROCESSOR SPEED ▶
SONY LAPTOP 4 GB BY LAPTOP WEIGHT ▶
SONY LAPTOP 4 GB PC
SONY LAPTOP 4 GB YES
2114
15.5 IN
14 IN
16.39 IN
13.1 IN
13.3 IN
17.3 IN
14.1 IN
18.39 IN
2118
PREFERENCES
2116

FIG. 21

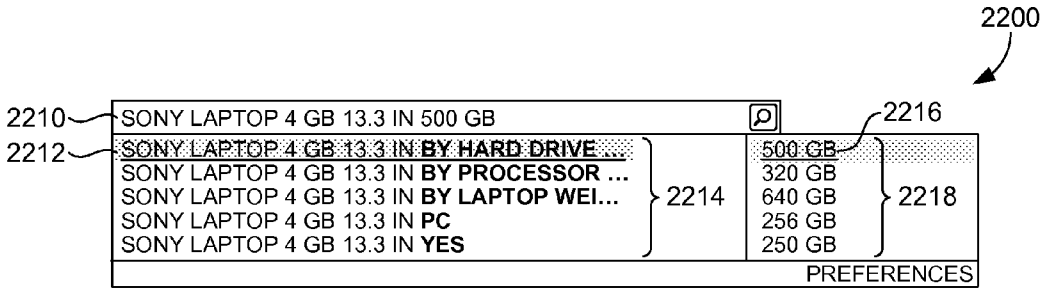
2200
2210
SONY LAPTOP 4 GB 13.3 IN 500 GB
2212
SONY LAPTOP 4 GB 13.3 IN BY HARD DRIVE ...
SONY LAPTOP 4 GB 13.3 IN BY PROCESSOR ...
SONY LAPTOP 4 GB 13.3 IN BY LAPTOP WEI...
SONY LAPTOP 4 GB 13.3 IN PC
SONY LAPTOP 4 GB 13.3 IN YES
2214
2216
500 GB
320 GB
640 GB
256 GB
250 GB
2218
PREFERENCES

FIG. 22

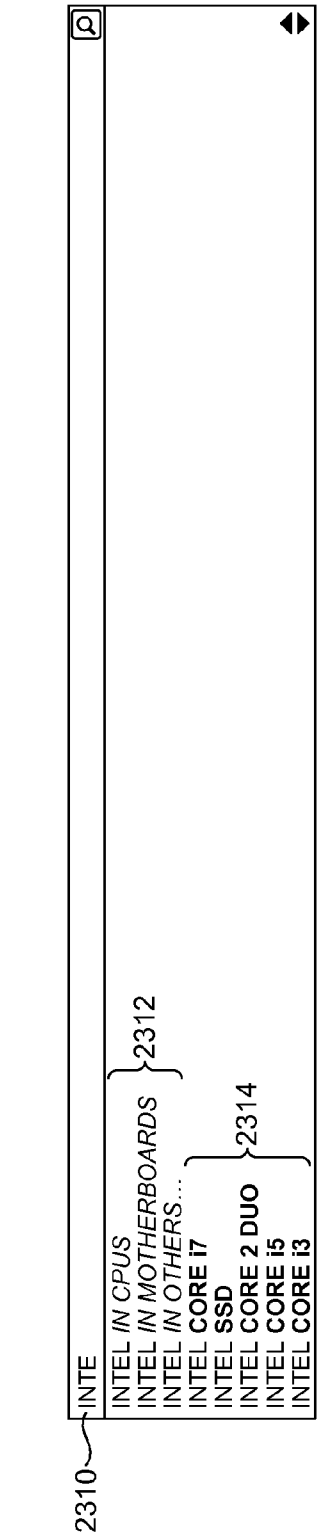
2300
2310
INTE
INTEL IN CPUS
INTEL IN MOTHERBOARDS
INTEL IN OTHERS...
INTEL CORE i7
INTEL SSD
INTEL CORE 2 DUO
INTEL CORE i5
INTEL CORE i3
2312
2314

FIG. 23

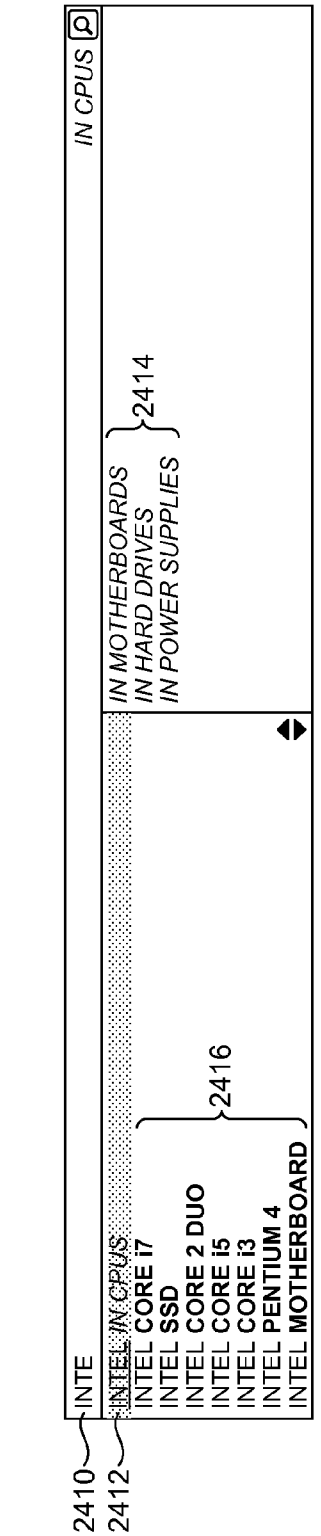
2400
2410
2412
INTE
IN CPUS
IN MOTHERBOARDS
IN HARD DRIVES
IN POWER SUPPLIES
INTEL IN CPUS
INTEL CORE i7
INTEL SSD
INTEL CORE 2 DUO
INTEL CORE i5
INTEL CORE i3
INTEL PENTIUM 4
INTEL MOTHERBOARD
2414
2416

FIG. 24

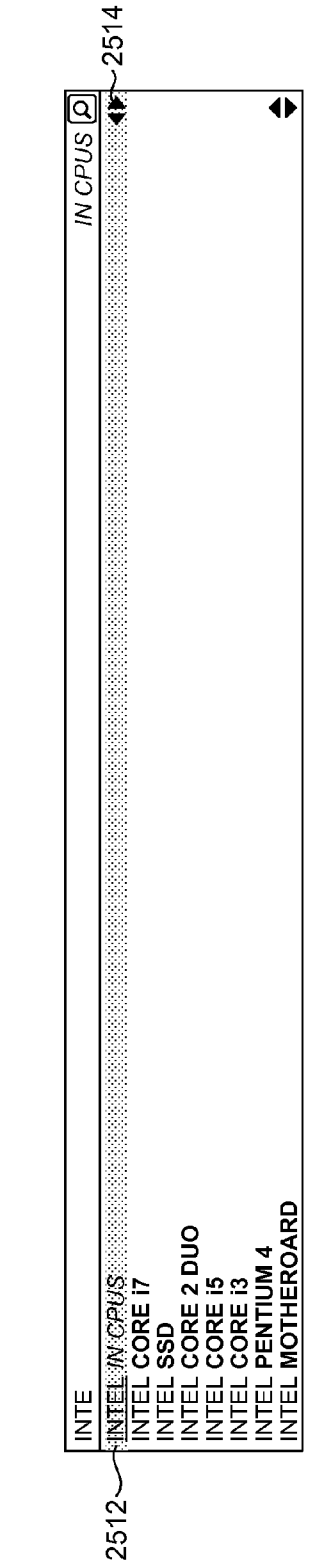
2500
2512
2514
INTE
IN CPUS
INTEL IN CPUS
INTEL CORE i7
INTEL SSD
INTEL CORE 2 DUO
INTEL CORE i5
INTEL CORE i3
INTEL PENTIUM 4
INTEL MOTHEROARD

FIG. 25

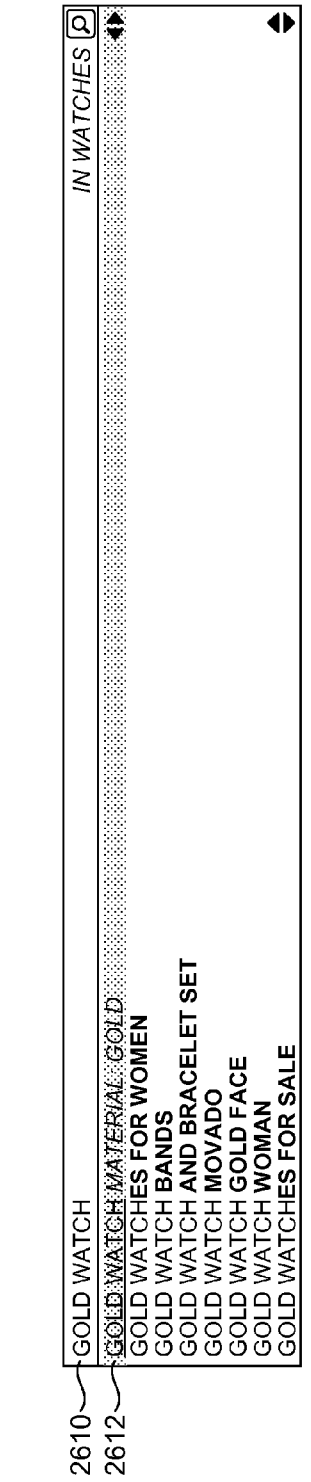
2600
2610
2612
GOLD WATCH
IN WATCHES
GOLD WATCH MATERIAL GOLD
GOLD WATCHES FOR WOMEN
GOLD WATCH BANDS
GOLD WATCH AND BRACELET SET
GOLD WATCH MOVADO
GOLD WATCH GOLD FACE
GOLD WATCH WOMAN
GOLD WATCHES FOR SALE

FIG. 26

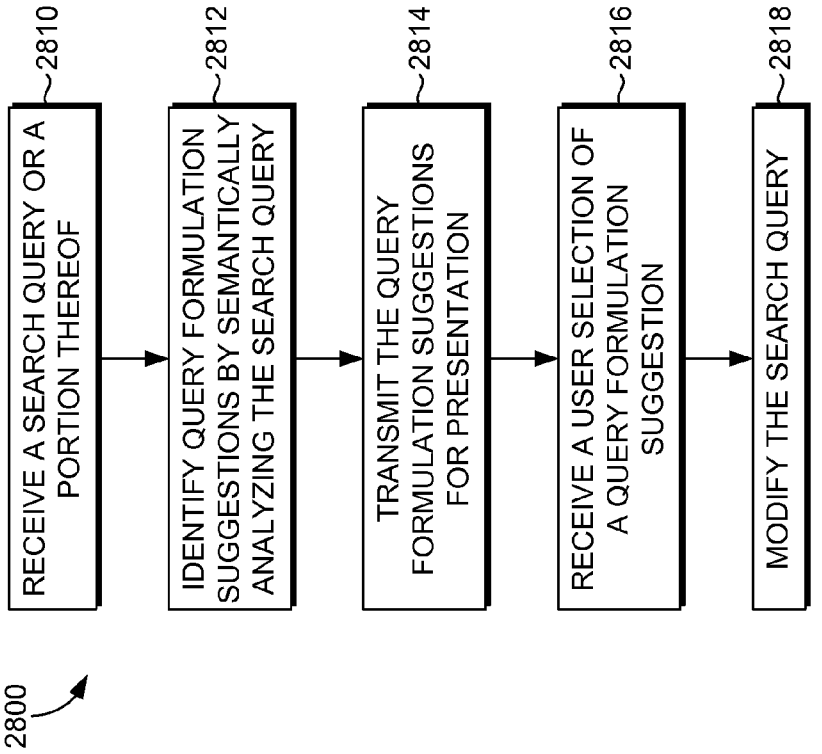
2800
RECEIVE A SEARCH QUERY OR A PORTION THEREOF
2810
IDENTIFY QUERY FORMULATION SUGGESTIONS BY SEMANTICALLY ANALYZING THE SEARCH QUERY
2812
TRANSMIT THE QUERY FORMULATION SUGGESTIONS FOR PRESENTATION
2814
RECEIVE A USER SELECTION OF A QUERY FORMULATION SUGGESTION
2816
MODIFY THE SEARCH QUERY
2818

FIG. 28

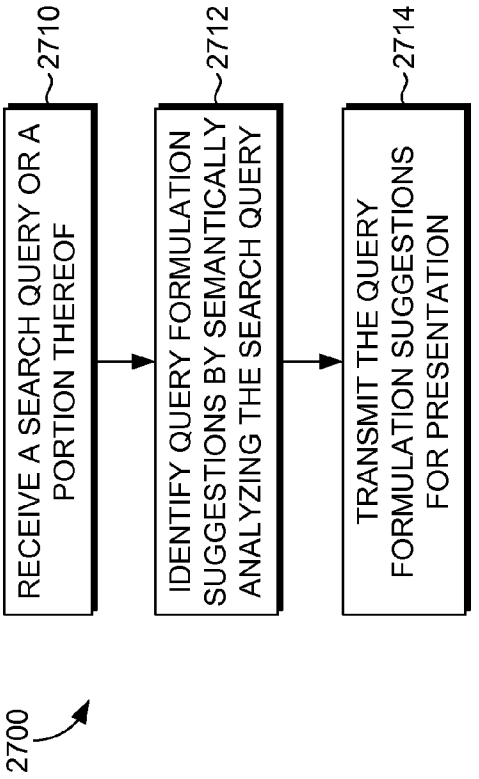
2700
RECEIVE A SEARCH QUERY OR A PORTION THEREOF
2710
IDENTIFY QUERY FORMULATION SUGGESTIONS BY SEMANTICALLY ANALYZING THE SEARCH QUERY
2712
TRANSMIT THE QUERY FORMULATION SUGGESTIONS FOR PRESENTATION
2714

FIG. 27

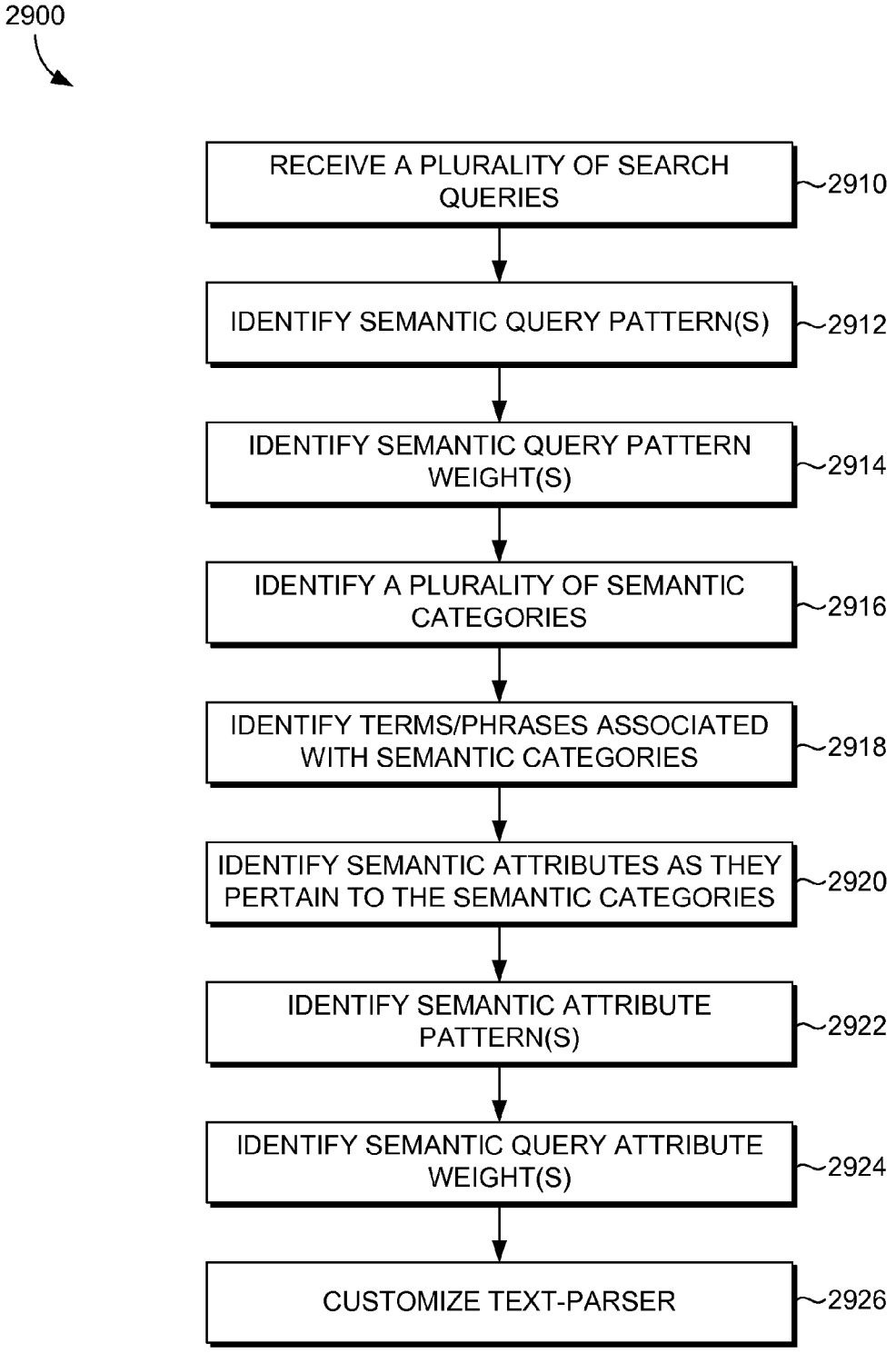
2900
RECEIVE A PLURALITY OF SEARCH QUERIES
2910
IDENTIFY SEMANTIC QUERY PATTERN(S)
2912
IDENTIFY SEMANTIC QUERY PATTERN WEIGHT(S)
2914
IDENTIFY A PLURALITY OF SEMANTIC CATEGORIES
2916
IDENTIFY TERMS/PHRASES ASSOCIATED WITH SEMANTIC CATEGORIES
2918
IDENTIFY SEMANTIC ATTRIBUTES AS THEY PERTAIN TO THE SEMANTIC CATEGORIES
2920
IDENTIFY SEMANTIC ATTRIBUTE PATTERN(S)
2922
IDENTIFY SEMANTIC QUERY ATTRIBUTE WEIGHT(S)
2924
CUSTOMIZE TEXT-PARSER
2926

FIG. 29

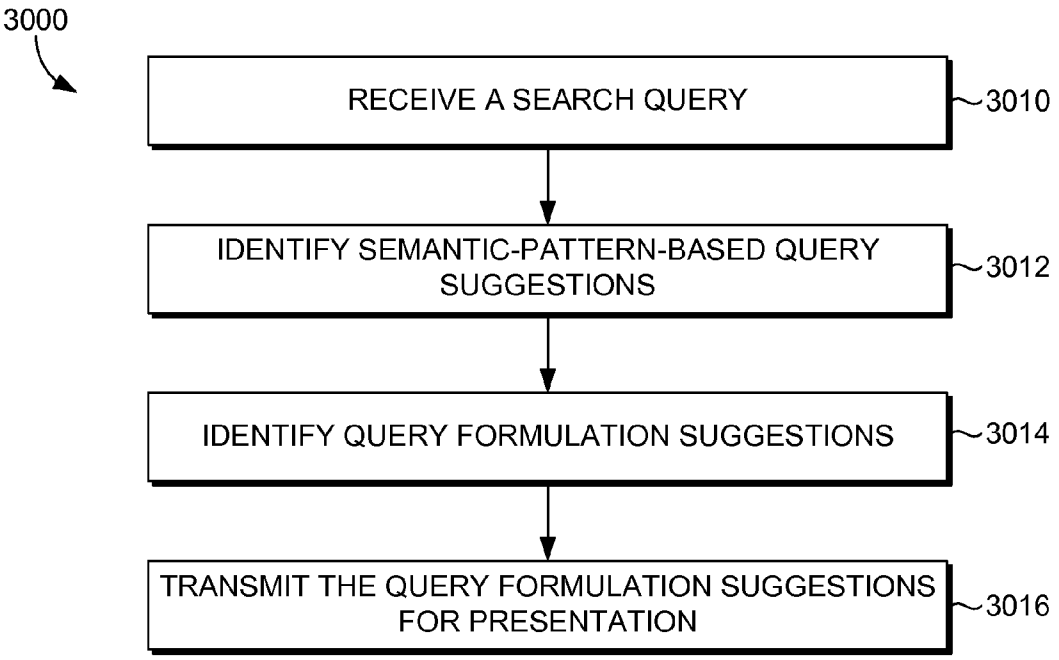
3000
RECEIVE A SEARCH QUERY
3010
IDENTIFY SEMANTIC-PATTERN-BASED QUERY SUGGESTIONS
3012
IDENTIFY QUERY FORMULATION SUGGESTIONS
3014
TRANSMIT THE QUERY FORMULATION SUGGESTIONS FOR PRESENTATION
3016

FIG. 30

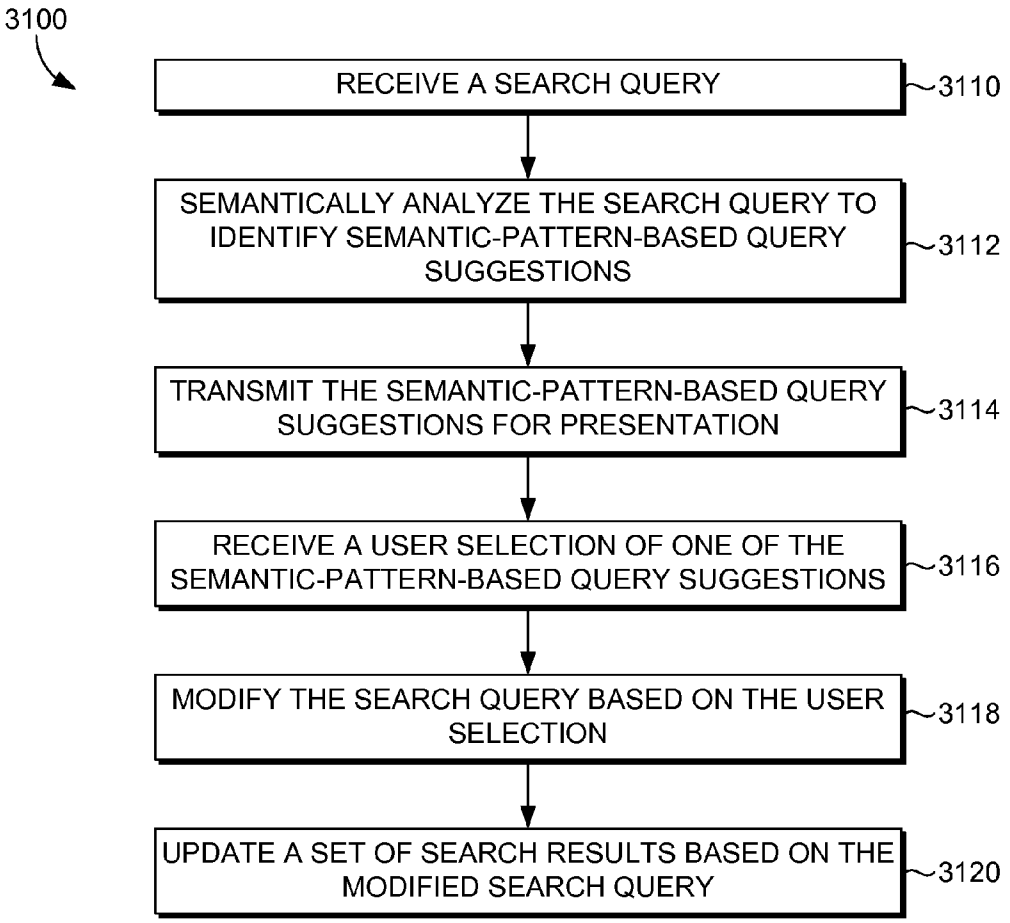
3100
RECEIVE A SEARCH QUERY
3110
SEMANTICALLY ANALYZE THE SEARCH QUERY TO IDENTIFY SEMANTIC-PATTERN-BASED QUERY SUGGESTIONS
3112
TRANSMIT THE SEMANTIC-PATTERN-BASED QUERY SUGGESTIONS FOR PRESENTATION
3114
RECEIVE A USER SELECTION OF ONE OF THE SEMANTIC-PATTERN-BASED QUERY SUGGESTIONS
3116
MODIFY THE SEARCH QUERY BASED ON THE USER SELECTION
3118
UPDATE A SET OF SEARCH RESULTS BASED ON THE MODIFIED SEARCH QUERY
3120

FIG. 31

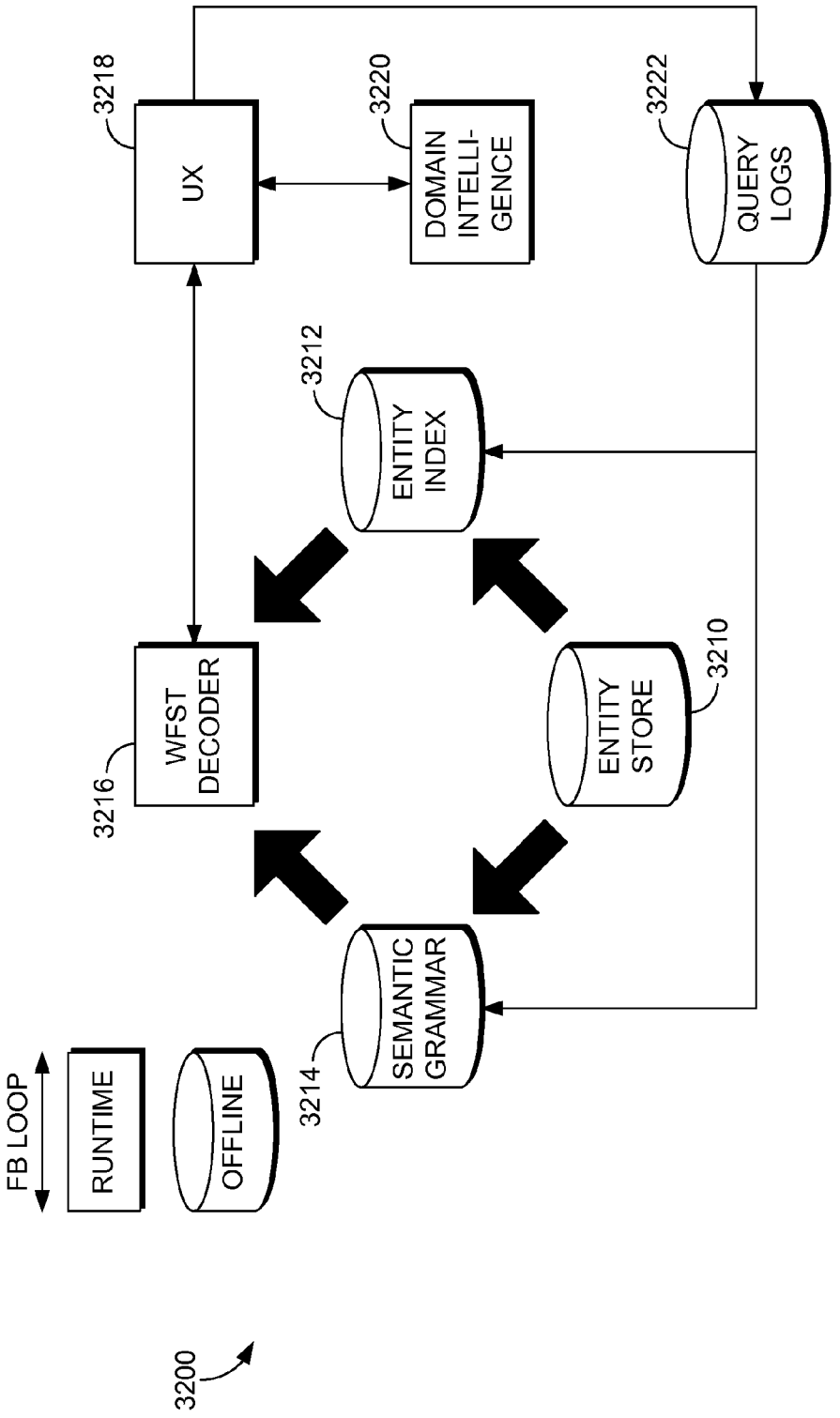
3200
FB LOOP
RUNTIME
OFFLINE
3214
SEMANTIC GRAMMAR
3216
WFST DECODER
3210
ENTITY STORE
3212
ENTITY INDEX
3218
UX
3220
DOMAIN INTELLI-GENCE
3222
QUERY LOGS

FIG. 32

ORDERING SEMANTIC QUERY FORMULATION SUGGESTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Provisional Patent Application No. 61/476,154 filed on Apr. 15, 2011 and entitled "Interactive Semantic Query Suggestion for Content Search. This application is further related by subject matter to U.S. patent application Ser. No. _____, entitled Interactive Semantic Query Suggestion for Content Search," filed on even date herewith (attorney docket number MS 332652.02/MFCP.162846). Both Provisional Patent Application No. 61/476,154 and U.S. patent application Ser. No. _____ (attorney docket number MS 332652.02/MFCP.162846) are hereby incorporated by reference as is set forth in their entirety herein.

BACKGROUND

[0002] Typically, search engines provide the user with an empty search box into which a user may input a search query and interact with the search system. For various reasons, search queries provided by users do not always accurately reflect the user's actual intent. While some search engines are capable of assisting users in completing search queries, e.g., by providing query completion suggestions, such query completion suggestions are typically generated based solely upon search queries that have been submitted in the past, such as the most popular search queries that begin with the alpha-numeric characters with which the user begins their query. As such, if a user begins entering the search query "wate," query completion suggestions may include "water for elephants," "water fountain," "water cycle," "watergate," etc. However, in many cases, the suggestions provided to the user may not reflect what the user is actually intending to search for as they are based solely on prior queries input by a collective group of users, and do not include unseen queries or queries that are seldom entered, but that may be what the user is intending to search for. Likewise, users have little, if any, knowledge about what information the search system may have available with regard to answering the task they have in mind. As such, the search system may not return satisfactory results to the user due, at least in part, to the system's failure to understand or disambiguate the user's actual intent, and to match the user's intent with useful information.

SUMMARY

[0003] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0004] Embodiments of the present invention relate to ordering or ranking semantically-identified query formulation suggestions. Semantic query patterns are identified for a plurality of search queries and a weight is identified for each. Also identified are a plurality of semantic categories, and each also has a weight identified therefore. Additionally, terms or phrases commonly associated with the semantic categories are identified, as are semantic attributes as they pertain to the semantic categories. Semantic attribute patterns and respective weights therefore are then identified. A text-parser is then generated or customized from the semantic query patterns and respective weights, the semantic category terms, and the semantic attribute patterns and respective weights, the text-parser for use in parsing input user queries or portions thereof. When a user search query is received, the text-parser is applied to determine at least one likely attribute, attribute value, term commonly associated with a semantic category, or a combination thereof and the determined attribute/attribute value/term is transmitted for presentation with an order or ranking representative of the respective calculated weights.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention is described in detail below with reference to the attached drawing figures, wherein:

[0006] FIG. **1** is a block diagram of an exemplary computing environment suitable for use in implementing embodiments of the present invention;

[0007] FIG. **2** is a block diagram of an exemplary system in which embodiments of the invention may be employed;

[0008] FIGS. **3-26** depict exemplary screen displays of graphical user interfaces, in accordance with various embodiments of the present invention;

[0009] FIGS. **27-31** illustrate flow diagrams of methods for identifying query formulation suggestions in response to receiving search queries, in accordance with embodiments of the present invention; and

[0010] FIG. **32** illustrates a block diagram of an exemplary system in which embodiments of the invention may be employed.

DETAILED DESCRIPTION

[0011] The subject matter of the present invention is described with specificity herein to meet statutory requirements. However, the description itself is not intended to limit the scope of this patent. Rather, the inventors have contemplated that the claimed subject matter might also be embodied in other ways, to include different steps or combinations of steps similar to the ones described in this document, in conjunction with other present or future technologies. Moreover, although the terms "step" and/or "block" may be used herein to connote different elements of methods employed, the terms should not be interpreted as implying any particular order among or between various steps herein disclosed unless and except when the order of individual steps is explicitly described.

[0012] Embodiments of the present invention provide for systems, methods and computer-storage media having computer-usable instructions embodied thereon, for building, linking, and exposing semantic knowledge of a search system or systems (e.g., query logs, facets, relationships of entities from structured and unstructured data, contextual signals, and the like) to assist users in query formulation and intent disambiguation. Embodiments of the invention may expose never-seen queries and provide better user-intent signals to the system. Such signals lead to selection and presentation of better and more relevant search results.

[0013] Accordingly, in one embodiment, the present invention is directed to a method performed by a computing device having a processor and a memory for identifying query formulation suggestions in response to receiving a search query. The method includes receiving at least a portion of the search query and identifying one or more query formulation sugges-

tions by semantically analyzing the at least the portion of the search query. The one or more query formulation suggestions comprise semantic-pattern-based query suggestions that are derived from semantic query patterns and at least one of one or more entities or information associated with the one or more entities. The method further includes transmitting the one or more query formulation suggestions for presentation.

[0014] In another embodiment, the invention is directed to a system comprising a processor and a memory for identifying query formulation suggestions in response to receiving a search query. The system includes a receiving component, a semantic analyzing component and a transmitting component. The receiving component receives at least a portion of a search query. The semantic analyzing component semantically analyzes the at least the portion of the search query to identify one or more query formulation suggestions that comprise semantic-pattern-based query suggestions that are derived from semantic query patterns and at least one of one or more entities or information associated with the one or more entities. The transmitting component transmits the one or more query formulation suggestions for presentation.

[0015] A further embodiment of the invention is directed to one or more computer-storage media storing computer-useable instructions that, when used by a computing device, cause the computing device to perform a method for identifying query formulation suggestions in response to receiving a search query. The method includes receiving at least a portion of the search query and, contemporaneous to a formulation of the at least the portion of the search query, identifying one or more query formulation suggestions by semantically analyzing the at least the portion of the search query. The one or more query formulation suggestions comprise query-log-based query suggestions and semantic-pattern-based query suggestions that are derived from semantic query patterns and at least one of one or more entities or information associated with the one or more entities. The information comprises one or more attributes and one or more attribute values. The method further includes transmitting the query formulation suggestions for presentation, wherein the query formulation suggestions are configured to be selectable by a user to formulate the search query. Still further, the method includes receiving a user selection of one of the query formulation suggestions, and modifying the at least the portion of the search query according to the selected query formulation suggestion.

[0016] Yet another embodiment of the invention is directed to a method performed by a computing device having a processor and memory for identifying query formulation suggestions. The method includes receiving at least a portion of a search query and identifying one or more semantic-pattern-based query suggestions by semantically analyzing the at least the portion of the search query. The one or more semantic-pattern-based query suggestions are derived from semantic query patterns, one or more entities, and information associated with the one or more entities, and the information includes attributes and attribute values such that the one or more entities are used to identify the one or more semantic-pattern-based query suggestions. The method further includes identifying a set of the query formulation suggestions to transmit for presentation, and transmitting the set of query formulation suggestions for presentation. The one or more query formulation suggestions are configured to be selectable by a user to formulate the search query.

[0017] In another embodiment, the invention is directed to one or more computer-storage media storing computer-useable instructions that, when used by a computing device, cause the computing device to perform a method for identifying query formulation suggestions. The method includes receiving at least a portion of a search query and semantically analyzing the at least the portion of the search query to identify one or more semantic-pattern-based query suggestions that are generated by at least one of semantic query patterns, one or more entities, and information associated with the one or more entities. The method further includes transmitting the one or more semantic-pattern-based query suggestions for presentation. The one or more semantic-pattern-based query suggestions being configured to be selectable by a user to formulate the search query. Still further, the method includes receiving a user selection of one of the one or more semantic-pattern-based query suggestions. In response to the user selection, the method additionally includes modifying the at least the portion of the search query based on the selected semantic-pattern-based query suggestion. Further, the method includes updating a set of search results based on the modified search query.

[0018] In another embodiment, the invention is directed to a user interface embodied on one or more computer-storage media, the user interface for presenting query formulation suggestions. The user interface includes a query display area, an attribute suggestion presenting area and an attribute value suggestion presenting area. The query display area is configured for displaying at least a portion of a search query received from a user, wherein the at least the portion of the search query is semantically analyzed to identify one or more semantic-pattern-based query suggestions by semantically analyzing the at least the portion of the search query, and wherein the one or more semantic-pattern-based query suggestions includes at least one of one or more entities, one or more attributes, or one or more attribute values. The attribute suggestion presenting area is configured for presenting a list of attributes as query formulation suggestions, each attribute in the list of attributes being associated with at least one of the one or more entities. The attribute value suggestion presenting area is configured for presenting a list of attribute values as the query formulation suggestions upon receiving a user selection of one of the attributes, each attribute value in the list of attribute values being associated with the selected attribute. The attribute value suggestion presenting area is arranged relative to the attribute suggestion presenting area such that the attribute values associated with a particular one of the attributes are presented in proximal association with their respective corresponding attributes.

[0019] In another embodiment, the invention is directed to one or more computer-storage media storing computer-useable instructions that, when used by a computing device, cause the computing device to perform a method for generating query formulation suggestions. The method includes receiving a plurality of search queries from a query log, each of the plurality of search queries being associated with a respective set of matching entities, and identifying at least one semantic query pattern from the plurality of search queries. The method further includes identifying a weight for each identified semantic query pattern; identifying a plurality of semantic categories from an entity database, each of the plurality of semantic categories being associated with a respective set of entities; identifying at least one term or phrase (e.g, an n-gram) commonly associated with at least one of the

semantic categories; identifying a plurality of semantic attributes as they pertain to the plurality of semantic categories; identifying at least one semantic attribute pattern from the plurality of semantic attributes; identifying a weight for each identified semantic attribute pattern; and generating a text-parser from the at least one semantic query pattern and respective weights, the at least one semantic category term or phrase and respective weights, and the at least one semantic attribute patterns and respective weights. The text parser is configured for use in parsing input user queries or portions thereof.

[0020] Having briefly described an overview of embodiments of the present invention, an exemplary operating environment in which embodiments of the present invention may be implemented is described below in order to provide a general context for various aspects of the present invention. Referring initially to FIG. **1** in particular, an exemplary operating environment for implementing embodiments of the present invention is shown and designated generally as computing device **100**. The computing device **100** is but one example of a suitable computing environment and is not intended to suggest any limitation as to the scope of use or functionality of the invention. Neither should the computing device **100** be interpreted as having any dependency or requirement relating to any one or combination of components illustrated.

[0021] Embodiments of the invention may be described in the general context of computer code or machine-useable instructions, including computer-executable instructions such as program modules, being executed by a computer or other machine, such as a personal data assistant or other handheld device. Generally, program modules including routines, programs, objects, components, data structures, etc., refer to code that performs particular tasks or implement particular abstract data types. Embodiments of the invention may be practiced in a variety of system configurations, including handheld devices, consumer electronics, general-purpose computers, more specialty computing devices, and the like. Embodiments of the invention may also be practiced in distributed computing environments where tasks are performed by remote-processing devices that are linked through a communications network.

[0022] With reference to FIG. **1**, the computing device **100** includes a bus **110** that directly or indirectly couples the following devices: memory **112**, one or more processors **114**, one or more presentation components **116**, input/output (I/O) ports **118**, I/O components **120**, and an illustrative power supply **122**. The bus **110** represents what may be one or more busses (such as an address bus, data bus, or combination thereof). Although the various blocks of FIG. **1** are shown with lines for the sake of clarity, in reality, delineating various components is not so clear, and metaphorically, the lines would more accurately be grey and fuzzy. For example, one may consider a presentation component such as a display device to be an I/O component. Also, processors have memory. The inventors recognize that such is the nature of the art, and reiterate that the diagram of FIG. **1** is merely illustrative of an exemplary computing device that can be used in connection with one or more embodiments of the present invention. Distinction is not made between such categories as "workstation," "server," "laptop," "handheld device," etc., as all are contemplated within the scope of FIG. **1** and reference to "computing device."

[0023] The computing device **100** typically includes a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by the computing device **100** and includes both volatile and nonvolatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer-storage media and communication media. Computer-storage media includes both volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer-storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by the computing device **100**. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

[0024] The memory **112** includes computer-storage media in the form of volatile and/or nonvolatile memory. The memory may be removable, non-removable, or a combination thereof. Exemplary hardware devices include solid-state memory, hard drives, optical-disc drives, and the like. The computing device **100** includes one or more processors that read data from various entities such as the memory **112** or I/O components **120**. Presentation component(s) **116** present data indications to a user or other device. Exemplary presentation components include a display device, speaker, printing component, vibrating component, etc.

[0025] The I/O ports **118** allow the computing device **100** to be logically coupled to other devices including I/O components **120**, some of which may be built in. Illustrative components include a microphone, joystick, game pad, satellite dish, scanner, printer, wireless device, and the like.

[0026] Referring now to FIG. **2**, a block diagram is provided illustrating an exemplary computing system environment **200** suitable for use in implementing embodiments of the present invention. It will be understood and appreciated by those of ordinary skill in the art that the computing system environment **200** shown in FIG. **2** is merely an example of one suitable computing system environment and is not intended to suggest any limitation as to the scope of use or functionality of embodiments of the present invention. Neither should the computing system environment **200** be interpreted as having any dependency or requirement related to any single module/component or combination of modules/components illustrated therein. Among other components not shown, the system **200** includes a user device **202**, a search engine **204**, an entity store **206** and a semantic suggestion generator **208**, all in communication with one another through a network **210**. The network **210** may include, without limitation, one or

more local area networks (LANs) and/or wide area networks (WANs). Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet. Accordingly, the network **210** is not further described herein.

[0027] In some embodiments, one or more of the illustrated components/modules may be implemented as stand-alone applications. In other embodiments, one or more of the illustrated components/modules may be integrated directly into other components. It will be understood by those of ordinary skill in the art that the components/modules illustrated in FIG. **2** are exemplary in nature and in number and should not be construed as limiting. Any number of components/modules may be employed to achieve the desired functionality within the scope of embodiments hereof. Further, components/modules may be located on any number of servers, search engine computing devices, or the like. By way of example only, the semantic suggestion generator **208** might reside on a server, cluster of servers, or a computing device remote from one or more of the remaining components.

[0028] It should be understood that this and other arrangements described herein are set forth only as examples. Other arrangements and elements (e.g., machines, interfaces, functions, orders, and groupings of functions, etc.) can be used in addition to or instead of those shown, and some elements may be omitted altogether. Further, many of the elements described herein are functional entities that may be implemented as discrete or distributed components or in conjunction with other components/modules, and in any suitable combination and location. Various functions described herein as being performed by one or more entities may be carried out by hardware, firmware, and/or software. For instance, various functions may be carried out by a processor executing instructions stored in memory.

[0029] The entity store **206** is configured to store various types of information used by the semantic suggestion generator **208** to identify query formulation suggestions based on a semantic analysis of at least the portion of the search query entered by the user. The type of information stored in the entity store **206** may include, for example, entities, categories, attributes, and attribute values, as more fully described below. More specifically, in various embodiments, the information stored in the entity store **206** may include, without limitation, entities or items (e.g., products available for commerce, locations, people, companies, organizations, and the like), categories to which such entities may correspond, attributes associated with the entities, and attribute values associated with the entities as they pertain to particular attributes thereof. The information in the entity store **206** may also include common queries that previously have been issued or submitted to the search engine **204**, in addition to popular or frequently selected interpretations. In an embodiment, at least a portion of these common queries may be stored in a query log such that the query log may be accessed to identify common queries.

[0030] The information stored in the entity store **206** may be used as query formulation suggestions. Query formulation suggestions, as used herein, refer to information that can be used to discover a user's true intent by assisting the user to formulate a query, for instance, by expanding upon or clarifying a partial query that has been entered by the user. As such, in one embodiment, query formulation suggestions are first presented prior to the determination and/or presentation of any search results determined to satisfy the query (or partial query). As will be discussed in further detail, in embodiments hereof, search results may be determined and presented when an input search query, or portion thereof, reaches a semantic boundary. As such, if a partial search query is entered, query formulation suggestions may be presented before search results are even identified. However, once the input query is modified to the point that a semantic boundary is reached, search results may be determined and presented. One or more different or updated query formulation suggestions may then be presented based on the modified search query. Thus, those of skill in the art will understand that query formulation suggestions differ from search results not only in content (although in some instances the content may be substantially similar), but also in their use upon user selection thereof. Selection and use of query formulation suggestions is more fully described below.

[0031] Query formulation suggestions may include various types of suggestions for formulating queries including, by way of example and not limitation, query-log-based query suggestions, semantic-pattern-based query suggestions (e.g., template-based query suggestions), categories associated with a search query, attributes associated with one or more identified entities, and attribute values associated with one or more identified entities. It should be noted that query formulation suggestions are generally identified, presented, and selected contemporaneously with query formulation, not post-query submission.

[0032] "Query-log-based query suggestions" are suggestions that attempt to aid the user in formulation of a search query by providing the user with the most popular previously-submitted search queries identified from a query log that correspond to the character sequence entered into the search box at a particular instance. "Semantic-pattern-based query suggestions," on the other hand, refer to query formulation suggestions that are generated from semantic query patterns (e.g., templates). When a search query, or portion thereof, is submitted to the search system, a database of semantic query patterns (such as "<brand>camera," as more fully described below) is accessed and an attempt is made to identify one or more semantic query patterns that correspond in some way to the input search query. In generating semantic-pattern-based query suggestions, a database or entity store **206** may be used. By accessing entities and their respective associated information from the entity store **206**, it can be ensured that only those semantic-pattern-based query suggestions that match known entities are returned. As such, before being presented to a user, semantic-pattern-based query suggestions are compared to entities stored in the entity store **206**. In one embodiment, if a particular semantic-pattern-based query suggestion is not found in the entity store **206**, it is not returned to the user as a query suggestion, as it may not exist (e.g., such as a particular product that does not exist), or at least it does not match with the known information in the entity store **206**. But if it is found, it may be returned to the user, as further discussed herein. Semantic-pattern-based query suggestions may be presented to the user in much the same way as query-log-based query suggestions.

[0033] "Entities," as used herein are items having known information (e.g., categories, attributes, and attribute values) associated therewith that is organized and stored in the entity store **206**. In some instances, entities have associated categories, but in another instances they do not. "Categories," "attributes" and "attribute values," as these terms are utilized herein, represent various hierarchical characteristics of enti-

ties and are useful in filtering or formulating received search queries (or portions thereof) for providing a user with as accurate an answer to a particular query as possible. While an entity is described herein as a particular product in one embodiment, in other embodiments, entities may also include other items that are not considered "products." For instance, for exemplary purposes only, entities may include a particular product, a business, an organization, a person, or the like. Further, an entity may be a specific location that has associated categories, attributes, and attribute values from which the user may select to formulate the search query. The definition of an entity, as used herein, is not meant to be limiting, but may apply to many things that are potentially capable of having associated hierarchical characteristics.

[0034] By way of example, suppose a user enters the character sequence "role" into the search query input area. As a result, "rolex" may be identified as a potential query formulation suggestion by either identifying it as a query-log-based query suggestion or as a semantic-pattern-based query suggestion. Here, "rolex" may be identified as a brand of watches, or may be a popular query, and may also correspond to one or more entities found in the entity index **206**. The entity "rolex" may be associated with the category "watches," and such category may be returned to the user as a suggested category that may then be utilized to further formulate the user's search. Similarly, if a user enters the alphanumeric characters "facebo" into the search query input area, it may lead to the identification of the query formulation suggestion "facebook," which may correspond to one or more entities in the entity store **206**. Further, the entities may include associated categories, such as "Web," such that an entered search query for "facebo" may return "Web" as a suggested category. This provides the user with an indication as to how the portion of the entered search query has been interpreted.

[0035] In embodiments, a received search query may be identical or substantially similar to an identified category. For example, the search query "digital cameras" may result in a plurality of entities having a category "digital cameras." While this would not in and of itself necessarily help in refining the user's search, armed with the knowledge that the category matches the intent of the user's search, various lower level hierarchical characteristics, e.g., attributes and attribute values, associated with the identified entity may be suggested to the user as possible query formulation suggestions. As another example, suppose the user enters the alphanumeric characters "digital slr" as a portion of a search query into the search query input area. The system of embodiments of the present invention may access the entity store **206** to determine one or more entities corresponding to the query "digital slr." Since there are several models of cameras that are SLR, there are likely several entities, if not hundreds of entities, that may be identified. The category in this instance may be "digital cameras." The previous description of categories may apply to even those situations where the query is not substantially similar to a stored category.

[0036] In embodiments, the entity store **206** is configured to be searchable for one or more of the items stored in association therewith. It will be understood and appreciated by those of ordinary skill in the art that the information stored in association with the entity store **206** may be configurable and may include any information relevant to entities, categorizations of entities, characteristics of entities, and the like. The content and volume of such information are not intended to limit the scope of embodiments of the present invention in any way. Further, though illustrated as a single, independent component, the entity store **206** may, in fact, be a plurality of storage devices, for instance, a database cluster, portions of which may reside on the semantic suggestion generator **208**, another external computing device (not shown), and/or any combination thereof.

[0037] As previously stated, the entity store **206** is configured to store attributes for entities as they pertain to particular categories. Attributes are characteristics of the entities belonging to a particular category that may be suggested to a user to further describe or refine the user's intent upon entering a search query. For example, attributes for the entity "Canon PowerShot SX30" may be associated with the category "digital cameras." The entity "Canon PowerShot SX30," by way of example only, may be associated with the attributes "megapixels," "color," "zoom," "lens," "viewfinder type," "image stabilization," "brand," "type," "model," and the like. These attributes may be used to further refine a search query for "Canon cameras," for example, to aid in discovering the user's true intent.

[0038] In addition to entities, categories and attributes for entities, the entity store **206** also is configured to store attribute values as they pertain to particular entities and associated attributes. For instance, for the attribute "color" associated with the entity "Canon PowerShot SX30," attribute values may include, for instance, "black," "blue," "red," "silver," etc. In general, values to suggest are identified by considering the distribution of value for all entities that match the current query. For example, for "canon cameras," there may be over 100 camera entities with "brand=canon." Among these, some are tagged with "color=black." Others may be tagged with "color=silver." The distribution of these values along with the score and popularity of the entities is used to determine the set and ranking of values presented to the user. Attribute values may be suggested to the user as query formulation suggestions to aid in further describing or refining the user's intent upon receiving a search query. This effectively blends browsing and searching experiences of web scale databases. As mentioned, attributes and attribute values are dependent upon the particular entity with which they are associated, and also are dependent upon the current state of the search query. For instance, if the search query already has a color specified, the attribute "color" may not even be presented to the user. Similarly, if the user has specified in the search query or has already selected an attribute value of "Canon," the system may not present the attribute of "brand" to the user.

[0039] While described in the context of search queries and assisting the user to define a search query, embodiments of the present invention may also be used in the context of related search, related categories, related concepts, etc. For instance, in one embodiment, alternative categories may be displayed for the user in addition to the best category associated with the entities that correspond to the search query. These alternative categories can be selected by the user if the user is not satisfied with the category chosen by the system. This functionality is further described below.

[0040] With continued reference to FIG. **2**, each of the user device **202**, the search engine **204** and the semantic suggestion generator **208** may be any type of computing device, such as computing device **100** described with reference to FIG. **1**, for example. The components may communicate with each other via a network **210**, which may include, without limitation, one or more local area networks (LANs) and/or wide

area networks (WANs). Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets, and the Internet. It should be understood that any number of user devices, segments, and hybrid-distribution system servers may be employed within the system **200** within the scope of the present invention. Each may comprise a single device or multiple devices cooperating in a distributed environment. For instance, the search engine **204** may comprise multiple devices arranged in a distributed environment that collectively provide the functionality of the search engine **204** described herein. Additionally, other components not shown may also be included within the system **200**, while components shown in FIG. **2** may be omitted in some embodiments.

[0041] The user device **202** may be any type of computing device owned and/or operated by an end user that can access the network **210**. For instance, the user device **202** may be a desktop computer, a laptop computer, a tablet computer, a mobile device, or any other device having network access. Generally, an end user may employ the user device **202** to, among other things, access electronic documents by submitting a search query to the search engine **204**. For instance, the end user may employ a web browser on the user device **202** to access and view electronic documents stored in the system **200**. According to embodiments of the present invention, the user additionally may be able to interact with the user device **202** by selecting an attribute and an attribute value, which further refines an input search query, as more fully described below. While the user device **202** has been described as communicating by way of the network **210**, embodiments of the present invention may also be used locally on a device, such as to improve desktop search, email search, or application search on Smartphone, and as such a network, such as the network **210**, may not be required.

[0042] The search engine **204** may comprise multiple components that are responsible for receiving an entered search query and identifying one or more documents that are relevant to that particular search query. In embodiments of the present invention, multiple sets of relevant documents may be presented to the user over the course of time from when the search query is first entered, to when a satisfactory response is received by the user through search query formulations utilizing attributes, attribute values, and the like. As such, the search engine **204** and the semantic suggestion generator **208**, in one embodiment, are generally in communication with one in another while a particular search query is being developed or completed. In an alternative embodiment, the search engine **204** and the semantic suggestion generator **208** are not associated with each other. For instance, at each semantic boundary (e.g., completion of a term in the search query, addition of an attribute value to the search query), the search results are updated in one embodiment. The search engine **204** may utilize one or more search indexes that have indexed documents from the web so that the most relevant search results can be identified in an efficient manner. In addition to web documents, the search engine may provide results from semi-structured databases based on the semantic constraints specified in the query.

[0043] As mentioned, in one embodiment, search results are updated when a semantic boundary is reached, such as when a term in the search box has been completed. This may occur when a new term has been added to the search query by either user input or by a user selection of a query formulation suggestion, which causes the search query to be modified according to the selected query formulation suggestion.

[0044] As shown in FIG. **2**, the semantic suggestion generator **208** includes a receiving component **212**, a semantic pattern identifying component **214**, a constraint index **216**, a category identifying component **218**, an attribute identifying component **220**, an attribute value identifying component **222**, a query formulation suggestion generating component **224**, a transmitting component **226**, and a semantic analyzing component **228**. In some embodiments, one or more of the components **212**, **214**, **216**, **218**, **220**, **222**, **224**, **226**, and **228** may be implemented as stand-alone applications. In other embodiments, one or more of the components **212**, **214**, **216**, **218**, **220**, **222**, **224**, **226**, and **228** may be integrated directly into the operating system of a computing device such as the computing device **100** of FIG. **1**. It will be understood by those of ordinary skill in the art that the components **212**, **214**, **216**, **218**, **220**, **222**, **224**, **226**, and **228** illustrated in FIG. **2** are exemplary in nature and in number and should not be construed as limiting. Any number of components may be employed to achieve the desired functionality within the scope of embodiments hereof.

[0045] Additional components of the semantic suggestion generator **208** (not shown) may include, without limitation, a processing unit, internal system memory, and a suitable system bus for coupling various system components, including one or more data stores for storing information (e.g., files and metadata associated therewith). The semantic suggestion generator **208** typically includes, or has access to, a variety of computer-readable media. By way of example, and not limitation, computer-readable media may include computer-storage media and communication media. In general, communication media enables each computing device to exchange data via a network, e.g., network **210**. More specifically, communication media may embody computer-readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave or other transport mechanism, and may include any information-delivery media. As used herein, the term "modulated data signal" refers to a signal that has one or more of its attributes set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared, and other wireless media. Combinations of any of the above also may be included within the scope of computer-readable media.

[0046] It will be understood by those of ordinary skill in the art that computing system environment **200** is merely exemplary. While the semantic suggestion generator **208** is illustrated as a single unit, one skilled in the art will appreciate that the semantic suggestion generator **208** is scalable. For example, the semantic suggestion generator **208** may in actuality include a plurality of computing devices in communication with one another. Moreover, the entity store **206**, or portions thereof, may be included within, for instance, the semantic suggestion generator **208**, a Website source, or a third-party service as a computer-storage medium. The single unit depictions are meant for clarity, not to limit the scope of embodiments in any form.

[0047] The receiving component **212** is configured to receive search queries, or portions thereof, input by users (e.g., users of user device **202**). Such information may be received in real-time upon entry by a user. Search queries may

also be received by the receiving component **212** from one or more query logs having historical query information included therein for one or both of a particular user and a group of users as a whole. Received search queries, or portions thereof, may be semantically analyzed, as further described herein, to identify one or more query formulation suggestions to present to the user as suggestions for formulating the current search query. Semantically analyzing at least a portion of a search query comprises hypothesizing the user intended task or category and extracting specified attribute values by tagging words in the query with their attributes. For instance, the query "red canon digital camera" may be identified as a category=digital camera, brand=canon, and color=red. Query formulation suggestions may be generated, in one instance, using templates associated with queries, attributes, categories, attribute values, etc. Thus, the receiving component **212** is additionally configured to receive information from the entity store **206**. The receiving component **212** is further configured to receive indications of user selections of query formulation suggestions. Such indications may be received, by way of example only, from user device **202**.

[0048] The semantic pattern identifying component **214** is configured to identify semantic patterns associated with queries, categories, attributes and attribute values. In embodiments, the semantic pattern identifying component **214** identifies key terms/phrases commonly associated with categories corresponding to particular entities. As mentioned, semantic patterns are similar to templates, in that at least a portion of a semantic query pattern identifies a particular category or attribute that is filled in based on the received search query. Templates may be stored in a semantic grammar index, for instance, as shown herein in FIG. **32**.

[0049] In embodiments, semantic query patterns may be identified algorithmically from information stored in query logs and/or the entity store **206**. Semantic query patterns, that is, linguistic patterns contained in received queries, will vary among languages and are determined based upon knowledge of how particular entities are commonly phrased in the language in which a search query is received. Alternatively or additionally, for instance in situations where standard language-specific linguistic patterns are unable to be identified or are clearly not followed, semantic query patterns of interest may be identified manually via editorial intervention.

[0050] In embodiments, weights or probabilities (that is, the likelihood of a particular semantic query pattern being a pattern that represents the true intent of a user) also may be determined by the semantic pattern identifying component **214**. In embodiments, such weights may be determined based upon one or both of availability and interest. In terms of availability, the semantic pattern identifying component **214** may examine the data contained in the entity store **206** and estimate how frequently particular items or entities are likely to occur. For instance, in a commerce setting, the semantic pattern identifying component **214** may examine the data on product availability that is contained in the entity store **206** and estimate how frequently each entity is likely to be offered or available. The more frequently a particular entity will be offered or available, the higher the probability or weight assigned to that entity will be.

[0051] In terms of interest, the semantic pattern identifying component **214** may examine input user queries and/or user-behavior with respect to the entities stored in association with the entity store **206**, and generate a weight that represents relative user interest in a particular entity. For instance, in the commerce setting, the semantic pattern identifying component **214** may examine user queries and/or behavior with respect to a particular product and estimate the relative interest of users in that product. Products with higher user interest will then be assigned a higher probability or weight. In embodiments wherein both availability and interest are utilized to determine weights or probabilities of given entities/items, a single weight representing some combination of the availability weight and the user interest weight may be determined.

[0052] In embodiments, semantic attribute value patterns may be identified algorithmically from information stored in query logs and/or the entity store **206**. Semantic attribute value patterns, that is, linguistic patterns contained in attribute values, will vary among languages and are determined based upon knowledge of how particular entities are commonly phrased in the language in which an attribute value is identified. Alternatively or additionally, for instance in situations where standard language-specific linguistic patterns are unable to be identified or clearly are not followed, semantic attribute value patterns of interest may be identified manually via editorial intervention.

[0053] The constraint index **216** is configured to extract entities from the entity store **206** with their respective categories, attributes, attribute values and corresponding weights and to determine unreasonable semantic patterns for each entity—that is, to determine semantic patterns that are illogical or are highly unlikely. Thus, if a particular category is rarely in the entity store **206** associated with an entity having a particular attribute, that category/attribute pair would be determined to be illogical for the particular entity. More commonly, constraints among attributes within a particular category may be applied such that the term "Microsoft PlayStation" is not suggested because the brand "Microsoft" and the product "PlayStation" are incompatible. The constraint index **216** may be utilized to filter query formulation suggestions, which will be discussed further herein. In some instances, the constraint index **216** also filters semantic patterns identified by the semantic pattern identifying component **214** if an attribute is inconsistent with currently specified constraints. This functionality is more fully described below. In embodiments, the constraint index **216** is further configured to build a compressed binary representation of the extracted data.

[0054] In embodiments, the constraint index **216** is configured to build a compressed binary entity index that allows the semantic suggestion generator **208** to efficiently determine the top attributes and attribute values matching a given set of constraints in a particular category and an optional prefix, along with their weights. In this way, hypotheses that cannot be true can be quickly eliminated leading to increased efficiency in arriving at suggestions to aid in determining user intent. For instance, if the user is searching a directory that is organized alphabetically and the user inputs the character "a," the compressed binary entity index can quickly filter the directory and eliminate all items not beginning with the character "a."

[0055] The category identifying component **218** is configured to identify the top category associated with a query. In embodiments, the category identifying component **218** is further configured to identify one or more categories that are related to the query, but that may not have been initially selected as the category thought to be most relevant to the search query. In embodiment, categories are stored in the entity store **206** in relation to their associated entities. In some

embodiments, an entity may not have an associated category, and as such a category is not displayed on the user interface.

[0056] Similarly, the attribute identifying component **220** is configured to identify at least one attribute associated with an entity. Attributes, as used herein, classify different attributes associated with an entity, and are specific to the entity to which they correspond. For instance, one entity may be associated with a particular attribute, but that attribute may not be associated with a different entity. In embodiments the attribute identifying component **220** is further configured to identify one or more attributes that are related to the entity, but that may have not been identified as one of the most relevant attributes. Further, the attribute value identifying component **222** is configured to identify at least one attribute value associated with an entity. Attribute values, as used herein, are values that correspond directly to the attribute and entity to which they correspond. For example, if a specific type of watch does not come in the color purple, "purple" is not displayed to the user as an attribute value corresponding to the attribute "color." For example, one entity may be associated with a particular attribute, but that attribute may not be associated with a different entity. In embodiments the attribute value identifying component **222** is further configured to identify one or more attribute values that are related to the entity but may not have been identified as one of the most relevant attributes.

[0057] The query formulation suggestion generating component **224**, given a search query (or portion thereof), is configured to construct a lattice of possible interpretations of the input query (or query portion). The lattice is dynamically composed utilizing the semantic patterns identified by the semantic pattern identifying component **214** and applying a search algorithm (for instance, the A* search algorithm well known to those of ordinary skill in the art) to find the search query completion path or paths that represent the most likely intent of the user while preserving the constraints imposed by the constraint index **216**. These types of algorithms can also find extensions of a partial inputted search query. Those completion paths (refined queries) identified as most likely intended by the user are those that are identified as having the highest overall weights, that is, the highest probabilities.

[0058] The transmitting component **226** is configured to transmit query formulation suggestions, which may take the form of query-log-based query suggestions, semantic-pattern-based query suggestions, entities, categories, attributes, attribute values, or the like for presentation. For instance, the query "digital ca" may result in a query-log-based query suggestion of "digital camera." Similarly, the query "canon in ca." may result in a category completion (e.g., query formulation suggestion) of "canon in cameras." Further, the query "cameras by br" may result in the attribute completion (e.g., query formulation suggestion) of "cameras by brand." The query "cameras by can" may result in an attribute value completion (e.g., query formulation suggestion) of "cameras by canon."

[0059] The semantic analyzing component **228** is configured to semantically analyze a received search query, or a portion thereof in order to identify the most relevant query formulation suggestions based on the received search query. In embodiments, algorithms are used to semantically analyze search queries. In one embodiment, as previously described, semantic-pattern-based query suggestions are derived using semantic query patterns and the entity store. For instance, semantic-pattern-based query suggestions may be compared to known entities in the entity store prior to being transmitted for presentation. For example, for the partial query "canon ca," the system searches through query records, query/attribute templates, category, etc. to find possible completions of the query that are also consistent with the known information in the entity store **206**. Suppose that "<brand>camera" is in the "digital camera" category and "<brand>car stereos" is in the "car stereos" category as query templates. Possible semantic-pattern-based query suggestions may include, for exemplary purposes only, "canon camera" and "canon car stereos." However, when consulting with the entity store **206**, it is determined that there is no such entity associated with the category "car stereos" with the brand "canon." This indicates that "canon car stereos" is an invalid query formulation suggestion, and thus is not provided as a suggestion.

[0060] In some instances, multiple query templates are stored for different categories that match the same query. For example, the partial query "can" may be completed to "canon" using the template "<brand>" in both the "digital camera" and "printers" category. In other words, there are entities in both categories with "canon" as the brand. In such scenarios, we show category disambiguation for the completion suggestion "canon," as further described herein. It is possible that there are other completions for "can" that are also ambiguous, such as "candy" as a type of food or the name of a movie. Thus, within a single suggestion list, there may be multiple completion suggestions that are category ambiguous.

[0061] Once potential query completion suggestions are identified, if a user selects a completion or if the system has a high enough confidence for a particular completion, the system may further identify query formulation suggestions for that particular completion about which the system has a high degree of confidence. For example, if the system knows that "canon camer" completes to "canon camera" with a high probability, query formulation suggestions such as "canon camera by resolution," "canon camera by color," etc., may be presented to the user. Even if the user enters "canon camera," the system may still first try to complete the query before suggestion query formulation suggestions.

[0062] Utilizing the components **212**, **214**, **216**, **218**, **220**, **222**, **224**, **226**, and **228**, the semantic suggestion generator **208** is configured to construct a trie from one or more query logs, each query being annotated with its top weighted interpretations. Then, given a partial query, the semantic suggestion generator **208** is able to locate the top weighted completion paths from the trie and transmit them for presentation as query formulation suggestions. In instances wherein not enough suggestions are determined to qualify as "top" suggestions, for instance where a minimum threshold number of query formulation suggestions is desired, additional query formulation suggestions may be identified by the query formulation suggestion generating component **224** (even though they may not meet a minimum desired threshold weight, for instance). Any semantically duplicate suggestions may be eliminated. Because a trie structure is utilized, if a category/attribute/attribute value suggestion is the semantic prefix of one or more remaining suggestions, an attribute extension suggestion may be inserted below such category/attribute/attribute value suggestion upon presentation. In embodiments, the semantic suggestion generator **208** may render query trie suggestions with multiple interpretations as an annotated query with disambiguation information. These

embodiments are more fully described below with reference to the screen displays of FIGS. **3-26**.

[0063] Turning now to FIG. **3**, illustrated is a screen display of a user interface **300**, in accordance with an embodiment of the present invention. Initially, a search box **310**, or a query display area, is the area on the user interface where the user enters a search query. Here, the query "digital camera" **311** has been entered by a user into the search box **310**. Once the system receives the search query, a database, such as the entity store **206** illustrated in FIG. **2**, is accessed to first determine if one or more entities correspond to the received search query. If so, the system identifies a category associated with the one or more entities. In one embodiment, more than one category is identified such that one category is identified as the most relevant or best category, and the others may be displayed on the search results page as alternate or related categories. As shown in FIG. **3**, the identified category **313** is displayed in a different portion of the search box, such as the category display area. This may be called the category display area. The category may be displayed in a number of locations on the user interface **300**, but is shown in this location for exemplary purposes only. A search button **314** is illustrated, and allows the user to indicate that he or she would like the search to initiate.

[0064] A suggestion area **315**, as shown in FIG. **3**, displays query formulation suggestions. Here, the query formulation suggestions comprise a list of attribute suggestions **316** that are identified as being relevant to the matching entities. The attribute suggestions **316** include "brand," "megapixels," "color," "zoom," "lens," "viewfinder type," "image stabilization," and "type." Additional attribute suggestions, if there are any, may be viewed by using the up and down arrows **317**. In one embodiment, a user may select an attribute, which can assist the user in further defining the user's search query. In response to the submitted search query, search results **318** are displayed for the user. As mentioned, the attribute suggestions are stored in a database and are organized based the entities to which they correspond.

[0065] FIG. **4** illustrates another screen display of a user interface **400**, in accordance with an embodiment of the present invention. FIG. **4** illustrates a search box **410** with a search query **412** entered, which, here, is "digital camera." In the embodiment of FIG. **4**, query formulation suggestions, which comprises both query completion suggestions **414** and query formulation suggestions, which here comprises attribute suggestions **416**, are displayed in the suggestion area, which blends these two user experiences together. The user may be intending to look for digital camera reviews, which is a popular query suggestion, or may be looking for a specific type of digital camera, in which case the user may utilize the attribute suggestions **416**.

[0066] Referring to FIG. **5**, another screen display of a user interface **500** is illustrated, in accordance with an embodiment of the present invention. The search box **510** includes a search query **511** of "digital camera brand." Here, after viewing the user interface of FIG. **4**, the user has made a selection of "brand" attribute **518** out of the attribute suggestions **516** displayed in the suggestion area **513**. "Brand" is not actually added to the search query, but acts as a placeholder for an attribute value that may be selected by the user. Query completion suggestions **514**, which are suggestions that may have already been entered into the search engine by other users (e.g., popular search queries) are also displayed in this embodiment. A user selection of an attribute may take many forms, including a mouse click, hovering over the selection, selecting the "enter" key on a keyboard, a user's touch on a touchscreen, gestures, or the like. For instance, a user may simply hover over the "brand" attribute **518**. In this case, a list of attribute value suggestions **522** may be displayed in the suggestion area **520**. For example, the attribute value suggestions **522** listed are brands that manufacture digital cameras. As mentioned, not only are attribute suggestions stored in associated with entities, but attribute value suggestions are also stored such that when a user selects an attribute, as shown in FIG. **5**, attribute value suggestions associated with the selected attribute value can be identified from a database and displayed for user selection. The suggestion area **520** may be divided into two or more areas, most notably an attribute display area for displaying a list of attribute suggestions and an attribute value display area for displaying a list of attribute value suggestions.

[0067] In one embodiment, in addition to user a mouse or keyboard to select query formulation suggestions, the user may also select/filter these suggestions by typing or otherwise entering the name/template of the query formulation suggestion directly. For instance, the user may type "canon camera by res" or "canon camera 10 megap." In such instances, query completion suggestions may be presented that attempt to complete the attribute or value. Depending on the scenario, there may be multiple query completion suggestions such a scenario. For instance, a partial query of "canon camera b" may result in the query completion suggestions of, for example, "canon camera black," "canon camera blue," etc. There may also be additional query completion suggestions from previously seen queries (e.g., popular queries), such as "canon camera bag."

[0068] FIG. **6** illustrates another screen display of a user interface **600**, in accordance with an embodiment of the present invention. Here, continuing from FIG. **5**, the user has now selected a particular brand from the list of attribute value suggestions **614**. The user has selected the "Nikon" attribute value **612**. The user selection of an attribute may take on one of many forms of selection, including a mouse click, hovering over the name, pressing the "enter" key, etc. As a result of the user selection of the "Nikon" attribute value **612**, the search query **610** is further defined to now include "Nikon," and is now "digital camera Nikon." At this point, a semantic boundary has been reached. As such, the previous search results displayed for the search query "digital camera" may be updated to include the most relevant search results for "digital camera Nikon." Similarly, if the user would have selected "Sony" instead of "Nikon," "Sony" would have been added to the search query, thus further defining the user's actual intent.

[0069] FIG. **7** illustrates another screen display of a user interface **700**, in accordance with an embodiment of the present invention. Continuing from FIG. **6**, the search query **710** is now "digital camera Nikon." Displayed the suggestion area **712** is a list of query completion suggestions **714** and a list of query formulation suggestions, which here is a list of attribute suggestions **716**. However, the list of attribute suggestions **716** has changed since the last viewing of this list in FIG. **6**. Here, the attribute suggestions have been filtered. Since the user has already selected a brand, the "brand" attribute is no longer present and viewable in the list of attribute suggestions **716**. As such, the list of attribute suggestions **716** is dynamic in the respect that it understands that "brand" no longer needs to be shown to the user, as the other attribute suggestions not yet selected by the user are the ones

that will further help to define the user's true intent. The search results **718** are also shown in FIG. **7** and, as shown, have been updated to include only those results applicable to the most recent version of the search query.

[0070] FIG. **8** illustrates another screen display of a user interface **800**, in accordance with an embodiment of the present invention. The user has now entered the letter "s" onto the end of the search query **810**. In one embodiment, both the query completion suggestions and the query formulation suggestions, which here are attribute suggestions, are filtered based on the letter "s." For example, because "sale" begins with "s," the only query suggestion **812** displayed is "Nikon digital camera sale." Here, a lexical prefix match may not be performed, but instead a semantic prefix was applied where it has been identified that "digital camera Nikon" is equivalent to "Nikon digital camera." Additionally, only the attribute suggestions associated with the letter "s" or those attribute suggestions having attribute value suggestions associated with the letter "s" are displayed at this point. Here, the attribute suggestions **814** include "screen size," "color silver," and "memory type (SDHC, SD)." Again, these lists are dynamic such that each time the query is modified, both the query completion suggestions **812** and the query formulation suggestions, or attribute suggestions **814**, are filtered, and thus are also modified. In one embodiment, only the attribute suggestions are filtered and attribute value suggestions are not included. But, as shown in the embodiment of FIG. **8**, the attribute suggestions and attribute value suggestions for each attribute are filtered such that if the user is actually wanting to search for Nikon SD cards, that is easily found.

[0071] FIG. **9** illustrates another screen display of a user interface **900**, in accordance with an embodiment of the present invention. Continuing from FIG. **8**, the user has selected the "screen size" attribute **914** in the suggestion area **912**. As a result, "screen size" has been added to the query, but as shown, it is visually different (e.g., italics, underline, bold) than the rest of the query. This is because it is not actually being added to the query, but indicates that the user may select one of the attribute value suggestions **918** from the list in the attribute value display area **916**. It should be noted that the attribute value suggestions of screen size, in this case, are associated specifically with Nikon brand digital cameras, not any other brand, as the user as already selected "Nikon" as the brand to add to the search query. This is because the query has been refined to be specific to Nikon cameras, and as such associated entities would all be Nikon products. As such, if a different brand would have been chosen in FIG. **6**, the associated entities would also be different, and thus the screen sizes shown in FIG. **9** would be different, as they would be customized to the particular brand. As such, attribute value suggestions, even those that are associated with the same attribute, are dynamic in that they vary based on the entity(s) best corresponding to the current formulation of the search query.

[0072] FIG. **10** illustrates another screen display of a user interface **1000**, in accordance with an embodiment of the present invention. In the embodiment of FIG. **10**, the user has selected (e.g., clicked, hovered, enter key) the "memory type (SDHC, SD)" attribute/attribute value **1014** in the suggestion box **1012**. As mentioned, this attribute/attribute value **1014** is displayed as a result of the user adding "s" to the end of the search query in FIG. **8**. When the user selects "memory type (SDHC, SD)," the attribute value suggestions **1018** are displayed in attribute value display area **1016**. "Memory type" is added to the search query **1010**, but is visually distinct from the rest of the query to indicate that it isn't actually part of the query, but that the user has the option to select an attribute value associated with the "memory type" attribute.

[0073] FIG. **11** illustrates another screen display of a user interface **1100**, in accordance with an embodiment of the present invention. Continuing from FIG. **10**, the user has now selected the "SDHC" attribute value **1112** in the suggestion area. As shown, the search query **1110** has now been modified to add the selected "SDHC" attribute value **1112** selected by the user. Here, the selection, in one embodiment, may be actually pressing the enter key on a keyboard or using a mouse click to indicate that the user wants that attribute value to be part of the search query. "Memory type" is no longer shown in the search query, as an attribute value has now been selected. In one embodiment, the search results **1116** are updated at this point, as a semantic boundary has been reached (e.g., a term or terms have been added to the search query). Continuing from FIG. **11**, FIG. **12** illustrates that the user has now selected "SDHC" attribute value, and it has been added to the search query **1210**. Now, a list of attribute suggestions **1214** that have not already been selected or used by the user to formulate the query is displayed in the suggestion area **1212**. It can be seen that "memory type" and "brand" are not in the list of attribute suggestions **1214**, although they previously were in the list.

[0074] FIG. **13** illustrates another screen display of a user interface **1300**, in accordance with an embodiment of the present invention. Similar to that shown and described with respect to FIG. **8**, the user has now entered "b" into the search box at the end of the search query **1310**. The attribute suggestions and attribute value suggestions are filtered to display only those associated with the letter "b." In this case, two colors, blue, and black, start with "b," and thus are shown in the attribute/attribute value list **1314** in the suggestion area **1312**. As shown in FIG. **14**, the user interface, generally referred to as **1400**, illustrates that the user has selected the "color blue" attribute/attribute value **1410**. In FIG. **15**, the user interface, generally referred to as **1500**, illustrates that the search query **1510** now includes the word "blue," as this was selected by the user. The list of attribute suggestions **1512** is now different, as "color" is no longer an option because the user has already selected the color blue to further define the search query **1510**.

[0075] FIG. **16** illustrates another screen display of a user interface **1600**, in accordance with an embodiment of the present invention. In FIG. **16**, the search query **1610** is "digital camera canno" where the brand "Canon" has been incorrectly spelled by the user. In a circumstance where a term in the query is spelled incorrectly, embodiments of the present invention can be used to assist the user in understanding the user's actual intent. For instance, the attribute/attribute value suggestion **1612** "brand Canon" may be suggested to the user in the suggestion box as being an option that the user may choose to select, which would correct the spelling in the search query.

[0076] In one embodiment, while the user may initially enter the search query "digital camera" and eventually add more attribute values to the search query using the methods described herein, the system may reformulate or paraphrase the search query for the user as more information is added. So instead of "digital camera Nikon," the system may reformulate it to read "Nikon digital camera," which likely appeals more to the user as it is in a natural language format. Not only

may the query be reformulated in the search box, but it may also be in reformulated format on the search results page.

[0077] FIG. **17** illustrates an alternative embodiment than the embodiments described above, and depicts another screen display of a user interface **1700**. In FIG. **17**, the search query **1710** is "digital camera." Query completion suggestions **1712** and query formulation suggestions, including attribute/attribute values **1714**, are displayed in the suggestion box. But in the embodiment of FIG. **17**, the attribute suggestions are not listed separately from the attribute value suggestions. For instance, instead of just listing "brand" in the list of attribute suggestions and not displaying its corresponding attribute value suggestions until "brand" is selected by the user, here the user can see a sampling of the attribute value suggestions associated with each attribute. So "brand" becomes "brand (Canon, Nikon, . . .)." The others are similar, and are shown in the list of attribute/attribute values **1714**. In one embodiment, the attribute value suggestions that are ranked highest or that are top values for each attribute are those that are shown in the list of attribute suggestions/attribute value suggestions **1714**.

[0078] FIG. **18** illustrates yet another alternative embodiment of a screen display of a user interface **1800**, in accordance with an embodiment of the present invention. Here, an attribute **1814** "brand" has been selected, and an attribute value **1818** "Canon" has been selected from the list of attribute value suggestions **1816**. The search query **1810** now includes "brand Canon" **1812**. "Brand Canon" **1812** is not actually added to the query, but "Canon" is. The user may select the word "Canon" from the search query **1810** which results in a dropdown list of alternative brands of digital cameras. This may be easier for a user to change an attribute value than going through the process of selecting the attribute and selecting the desired attribute value. This same embodiment could be used with other attribute suggestions. In addition to the visual representation of the attribute and selected attribute value in the search box in FIG. **18**, other visual representations are also contemplated to be within the scope of the present invention, including just the display of the attribute value in a visually distinct way such that the user would know that he or she may select (e.g., hover, mouse click) over that attribute value to change it to a different attribute value.

[0079] FIGS. **19-22** illustrate progressive screen displays of user interfaces (**1900**, **2000**, **2100**, and **2200**), in accordance with embodiments of the present invention. In FIG. **19**, a search query **1910** of "Sony laptop" has been entered by a user. In response to this search query, the system determines whether there are any entities in the entity store, such as entity store **206** in relation to FIG. **2**, that are associated with the inputted search query. Entities are identified if the system has a high enough confidence as to what the user is searching for. If one or more entities are identified, query formulation suggestions, including attribute/attribute value suggestions **1912** and query completion suggestions **1914** are transmitted for presentation on the user interface **1900**. FIG. **19** illustrates an embodiment different from those previously discussed in that it lists various attribute suggestions with a few selected (e.g., most relevant, most popular) attribute value suggestions to give the user an idea of values associated with each attribute. As shown in FIG. **20**, the user has selected (e.g., mouse hover) the "Sony laptop by RAM" attribute **2012** from the list of attribute suggestions **2014**. Based on this selection, a list of attribute value suggestions **2018** associated with the selected attribute value **2012** is displayed. The user has selected the "4 GB" attribute value **2016** from the list of attribute value suggestions **2018**. Since an attribute value has been selected, the selected attribute value, "4 GB," is added to the search query **2010**. In one embodiment, since a semantic boundary has been reached, the search results would be updated to reflect the additional information in the search query.

[0080] FIG. **21** illustrates that a new and filtered list of attribute suggestions **2114** are displayed based on the user's previous selection of the "4 GB" RAM size. "RAM" is no longer an option in the attribute suggestions **2114**. Now, the user has selected to further define the search query **2110** by screen size, as indicated by the user's selection of the attribute **2112** "Sony laptop 4 GB by screen size." Note that in this embodiment, the current search query is included before each listed attribute. In other embodiments, the current search query may not be included in the listing of attribute suggestions, as shown in previous figures herein. Based on the user selection of the "screen size" attribute **2112**, a list of attribute value suggestions **2118** is displayed. The user has chosen to select the "13.3 in" attribute value **2116**, which is then added to the search query **2110**. In FIG. **22**, an updated list of attribute suggestions **2214** is presented to the user on the user interface **2200**. As mentioned, the updated list does not include previously-selected attribute suggestions for which the user has actually selected an attribute value that has been added to the query. As such, the lists of both attribute suggestions and attribute value suggestions are dynamic. The user has now selected the attribute "hard drive" **2212** from the list of attribute suggestions **2214**. As a result, a list of attribute value suggestions **2218** are displayed, and the user has selected the "500 GB" attribute value **2216**. "500 GB" has been added to the search query **2210**.

[0081] FIGS. **23-26** illustrate various embodiments of screen displays of user interfaces (**2300**, **2400**, **2500**, and **2600**) for providing attribute and attribute value suggestions based on a ambiguous search query. FIG. **23** illustrates a search query of "inte" **2310**. The system may be unsure of the user's intent, but can display query completion suggestions **2314** and query formulation suggestions, comprising attribute suggestions, that are thought to match the user's intent. Additionally, category suggestions **2312** may also be provided, as shown in FIG. **23**. Initially, the system finds the top completions for "inte" and then determines that the top completion "intel" is ambiguous. Because "intel" is ambiguous, the system may guess as to which categories the query could fit into and list the top categories from which the user may choose. Here, it is thought that the user is trying to search for Intel, and thus categories associated with Intel are displayed. This allows the user to accurately choose the direction in which the search will proceed (e.g., whether the user wants to search for CPUs or motherboards. FIG. **24** illustrates an alternative embodiment. Here, the user has selected "Intel in CPUs" **2412** as the category. Other categories **2414** not selected by the user are shown in a different portion of the suggestion area so that the user can choose a different category if "CPUs" is not the correct one. Query completion suggestions **2416** are also displayed. The query **2410** has not been modified yet, as an attribute value has not been selected. Further, the selected category is displayed in the search box.

[0082] FIG. **25** illustrates an alternative embodiment in that the user has selected the category "CPUs" **2512**, and alternate categories may be browsed by using the left and right arrow buttons **2514**. Here, CPUs may be the top category, and as

such it is the category that is displayed with the others hidden from view. There are many other ways that this type of information can be displayed for user selection, and are contemplated to be within the scope of the present invention. For example, the user may be able to select (e.g., hover) over the category name in the search box such that alternative categories would appear in a dropdown box. Or, arrows may be displayed next to the category name in the search box that allow the user to browse alternative categories. FIG. **26** illustrates how ambiguous interpretations may be handled. Here, the query is "gold watch" **2610**. Ambiguous attribute suggestions may be provided, as shown here. "Material: gold" is the best interpretation of the query. As such, the attribute suggestion of "material: gold" **2612** is displayed in the suggestion area, and as shown, has been selected by the user as illustrated by the shading.

[0083] Turning now to FIG. **27**, a flow diagram is shown of a method **2700** for identifying query formulation suggestions in response to receiving a search query, in accordance with an embodiment of the present invention. Initially, a search query or a portion thereof is received at step **2710** in a search query box, such as that illustrated in previous figures herein. The search query box may receive and display the user's search query. In embodiments, the search query entered by the user is not a complete search query, as the system described herein assists the user to complete the search query based on the user's true intent to find an answer by way of search results. At step **2712**, query formulation suggestions are identified by semantically analyzing the received search query or portion thereof. Query formulation suggestions comprise semantic-pattern-based query suggestions that are derived from semantic query patterns and entities and/or information associated with the entities. For instance, the search query may be semantically analyzed to identify one or more entities associated with the search query. As the search query may be a partial query, the system uses semantic analysis techniques to identify entities that are most likely what the user is searching for. In some instances, more than one entity is identified, such as more than one product corresponding to the search query "digital came." In one embodiment, a query formulation suggestion is selected as being most relevant to the search query, and the information (e.g., categories, attributes, attribute values) corresponding to the entities associated with the completion is presented to the user. In embodiments, the entity store is used to generate query formulation suggestions that complete the potentially incomplete query, where each of the query formulation suggestions corresponds to at least one entity.

[0084] The query formulation suggestions may be generated based on the identified entities. The query formulation suggestions may include, for example, categories, attributes, and attribute values which assist the user to formulate the search query. The query formulation suggestions are transmitted for presentation at step **2714**. As mentioned, query formulation suggestions may include categories, attributes, and attribute values. In some embodiments, there may not be any categories associated with an entity. In that case, no categories are presented to the user. But if any attributes or attributes values are known in relation to that entity, those may be presented to the user. The identified attribute suggestions may be displayed in a suggestion area, such as the suggestion area illustrated in various figures herein. In one embodiment, query-log-based query suggestions are also displayed in the suggestion area in addition to the attribute suggestions to provide the user with a blended experience that encompasses both query-log-based query suggestions (e.g., popular queries that have been submitted to the search engine in the past) and query formulation suggestions. The query formulation suggestions are configured to be selectable by a user. For instance, when the user selects a particular attribute value, such as "blue," the term "blue" is added to the search query to further define the user's intent.

[0085] Referring to FIG. **28**, a flow diagram of a method **2800** for identifying query formulation suggestions in response to receiving a search query is illustrated, in accordance with an embodiment of the present invention. At step **2810**, a search query is received, typically in a search box, which may both receive and display the search query. The search query entered by the user may not be a complete search query that clearly defines what the user is looking to find, but may be a partial search query. In one embodiment, the user may not press the search key or hit the enter key on a keyboard, but may still be typing when query formulation suggestions are displayed. At step **2812**, query formulation suggestions are identified by semantically analyzing the search query or portion thereof.

[0086] Query formulation suggestions associated with the identified entities are identified, and may include category suggestions, attribute suggestions, attribute value suggestions, etc. Categories may include product types (e.g., digital camera, video camera, watches, party supplies, smart phones) or may even include non-products, such as locations, ideas, or the like. Generally, attributes are groups of different aspects corresponding to a particular entity that are found or known to be relevant to that entity. At step **2814**, the query formulation suggestions are transmitted for presentation in, for example, a suggestion area, and are configured to be selected by a user to further formulate the search query. In one embodiment, the suggestion area is located on the user interface beneath the search box, but in other embodiments, is located in another location on the user interface.

[0087] A user selection is received of one of the query formulation suggestions at step **2816**. This user selection may include a hard selection (e.g., pressing the enter key on the keyboard, mouse clicking the attribute) or a soft selection (e.g., hovering over the attribute). In one embodiment, the user selection of an attribute is a hover of the mouse over the attribute, which causes attribute value suggestions to be displayed, as discussed below. Once a user selection is made, the query is modified at step **2818** based on the selected query formulation suggestion.

[0088] Attribute values are simply values that correspond to the selected attribute. For example, an attribute of color would potentially have values including, for example, blue, green, orange, red, etc. Attribute values are selectable by the user and help to further define and formulate the user's search query. It should be noted that both attribute suggestions and attribute value suggestions are dynamic lists and change based on the current form of the user's search query, category, etc. For instance, attribute values for the attribute "color" are different based on whether the category is a laptop or a car. Laptops made by Dell, for example, likely do not come in the same colors as a particular vehicle Likewise, laptops made by one manufactures may not come in the same colors as laptops made by another manufacture. Additionally, once a user has further defined the search query, the attribute associated with the additional term added to the search query may not be

visible in the list of attribute suggestions, since the user has already made a decision based on that particular attribute.

[0089] With reference now to FIG. **29**, a method, referenced generally by the numeral **2900**, is depicted, in accordance with an embodiment of the present invention. At step **2910**, a plurality of search queries is received, for instance, from a query log. Each of the plurality of search queries is associated with a respective set of matching entities. At step **2912**, at least one semantic query pattern is identified from the plurality of received search queries. A weight for each identified semantic query pattern is identified at step **2914**. At step **2916**, a plurality of semantic categories is identified, for instance, from an entity database (e.g., entity store **206** of FIG. **2**). Each of the plurality of semantic categories is associated with a respective set of entities. At step **2918**, at least one term or phrase (e.g., an n-gram) commonly associated with at least one of the semantic categories is identified. At step **2920**, a plurality of semantic attributes as they pertain to the plurality of semantic categories is identified. At least one semantic attribute pattern is identified from the plurality of semantic attributes at step **2922**. At step **2924**, a weight for each identified semantic attribute pattern is identified. At step **2926**, a text-parser is generated or customized from the at least one semantic query pattern and respective weights, the at least one semantic category term or phrase and respective weights, and the at least one semantic attribute patterns and respective weights.

[0090] The text-parser may be utilized in parsing input user queries or portions thereof, in accordance with embodiments herein above described. In one embodiment in this regard, at least a portion of an input user search query is received, the text-parser is applied to determine at least one likely attribute for expansion of the input user query, the likelihood being based upon the respective weights, and the at least one likely attribute is transmitted for presentation as an attribute suggestion. In embodiments, applying the text-parser to determine at least one likely attribute for expansion of the input user query may comprise applying the text-parser to determine a plurality of likely attributes for expansion of the input user query, each of the plurality of likely attributes having a calculated weight associated therewith. In embodiments, transmitting the at least one likely attribute for presentation as an attribute suggestion may comprise transmitting at least a portion of the plurality of likely attributes for presentation as attribute suggestions, the attribute suggestions representing the plurality of likely attributes or portion thereof that are transmitted for presentation being arranged in an order representing their respective calculated weights.

[0091] As can be seen, embodiments of the present invention provide for systems, methods and computer-storage media having computer-usable instructions embodied thereon, for building, linking, and exposing semantic knowledge of a search system or systems (e.g., query logs, facets, relationships of entities from structured and unstructured data, contextual signals, and the like) to assist users in query formulation and intent disambiguation, as well as query formulation. Embodiments of the invention may be scaled to tail and never-seen queries and can provide better user intent signals to the system for result matching and lead to better and more relevant search results.

[0092] FIG. **30** illustrates a flow diagram of a method **3000** for identifying query formulation suggestions in response to receiving a search query, in accordance with an embodiment of the present invention. At step **3010**, a search query or a portion thereof is received. At step **3012**, semantic-pattern-based query suggestions are identified by semantically analyzing the received search query. The semantic-pattern-based query suggestions are derived from semantic query patterns, entities, and information associated with the entities. The information includes attributes and attribute values such that the entities are used to identify the semantic-pattern-based query suggestions. The attribute suggestions and attribute value suggestions are configured to be selectable by a user to further formulate the search query. At step **3014**, a set of the query formulation suggestions are identified to transmit for presentation. At step **3016**, the set of query formulation suggestions are transmitted for presentation. These suggestions are configured to be selectable by a user to formulate the search query.

[0093] Turning now to FIG. **31**, a flow diagram of a method **3100** is illustrated for identifying query formulation suggestions in response to receiving a search query, in accordance with an embodiment of the present invention. At step **3110**, a search query or a portion thereof is received. The search query is semantically analyzed at step **3112** to identify semantic-pattern-based query suggestions that are generated by semantic query patterns, one or more entities, or information associated with the entities. The information may include categories, attributes, attribute values, etc. The semantic-pattern-based query suggestions are transmitted for presentation at step **3114**, and are configured to be selectable by a user to formulate the search query. At step **3116**, a user selection of one of the semantic-pattern-based query suggestions is received. In response to the user selection, the search query is modified at step **3118** based on the selected semantic-pattern-based query suggestion. At step **3120**, a set of search results is updated based on the modified search query. This indicates that a semantic boundary has now been reached.

[0094] Turning now to FIG. **32**, a block diagram is illustrated of an exemplary system in which embodiments of the invention may be employed. The entity store **3210**, as previously mentioned, stores entities and known information associated with entities. For instance, one or more of categories, attributes, or attribute values may be stored in the entity store **3210** in association with an entity. From the entity store **3210**, various files are generated, including an entity index **3212** and a semantic grammar file **3214**. The semantic grammar file **3214** predicts what the user will or wants to type, and additionally stores query patterns received from users along with attributes for each product category. It also stores previously observed queries along with their top interpretations. Further, the semantic grammar file **3214** stores templates that are used to generate query formulation suggestions, such as query templates, attribute templates, attribute value templates, category templates, and the like. The entity index **3212** stores an indexed representation of the entities stored in the entity store **3210**. These files are sent to a weighted finite state transfuser (WFST) decoder **3216**. The decoder receives notifications that the user has pressed a key, had a mouse click/event, etc. Every user event is considered by the decoder. From the decoder, the user experience (UX) component **3218** presents the query formulation suggestions to the user. The UX component **3218** interacts with the domain intelligence component **3220**, which is responsible for refreshing search results when a semantic boundary is reached. The domain intelligence component **3220** retrieves updated search results for presentation to the user. The query log database **3222** receives entered queries, user selections, etc. for recording purposes.

As shown in FIG. **32**, the cylindrical components are able to be calculated offline, or prior to receiving a search query. The rectangular components perform their respective functions online, or once the search query is entered by a user.

[0095] The present invention has been described in relation to particular embodiments, which are intended in all respects to be illustrative rather than restrictive. Alternative embodiments will become apparent to those of ordinary skill in the art to which the present invention pertains without departing from its scope.

[0096] From the foregoing, it will be seen that this invention is one well adapted to attain all the ends and objects set forth above, together with other advantages which are obvious and inherent to the system and method. It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

What is claimed is:

1. One or more computer-storage media storing computer-useable instructions that, when used by a computing device, cause the computing device to perform a method, comprising:

receiving a plurality of search queries from a query log, each of the plurality of search queries being associated with a respective set of matching entities;

identifying at least one semantic query pattern from the plurality of search queries;

identifying a plurality of semantic categories from an entity database, each of the plurality of semantic categories being associated with a respective set of entities;

identifying at least one term commonly associated with at least one of the semantic categories;

identifying a plurality of semantic attributes as they pertain to the plurality of semantic categories;

identifying at least one semantic attribute pattern from the plurality of semantic attributes; and

customizing a text-parser, at least in part, utilizing the at least one semantic query pattern, the at least one semantic category term, and the at least one semantic attribute patterns, the text parser for use in parsing input user queries or portions thereof.

2. The one or more computer-storage media of claim **1**, wherein the method further comprises:

identifying a weight for each identified semantic query pattern; and

identifying a weight for each identified semantic attribute pattern.

3. The one or more computer-storage media of claim **2**, wherein utilizing a text-parser generated, at least in part, from the at least one semantic query pattern, the at least one semantic category term, and the at least one semantic attribute patterns, comprises utilizing a text-parser generated, at least in part, from the at least one semantic query pattern and respective weights, the at least one semantic category term, and the at least one semantic attribute patterns and respective weights, the text parser for use in parsing user queries or portions thereof.

4. The one or more computer-storage media of claim **1**, wherein identifying at least one term commonly associated with at least one of the semantic categories comprises identifying at least one phrase commonly associated with at least one of the semantic categories.

5. The one or more computer-storage media of claim **1**, wherein identifying at least one term commonly associated with at least one of the semantic categories comprises identifying at least one n-gram commonly associated with at least one of the semantic categories.

6. The one or more computer-storage media of claim **2**, wherein the method further comprises:

receiving at least a portion of an input user search query;

applying the text-parser to determine at least one likely attribute, attribute value, term, or combination thereof for expansion of the input user query; and

transmitting the at least one likely attribute, attribute value, term, or combination thereof for presentation as an attribute suggestion.

7. The one or more computer-storage media of claim **6**, wherein applying the text-parser to determine at least one likely attribute, attribute value, term, or combination thereof for expansion of the input user query comprises applying the text-parser to determine a plurality of likely attributes, attribute values, terms, or any combination thereof for expansion of the input user query, each of the plurality of likely attributes, attribute values, terms, or any combination thereof having a calculated weight associated therewith.

8. The one or more computer-storage media of claim **7**, wherein transmitting the at least one likely attribute, attribute value, term, or combination thereof for presentation as an attribute suggestion comprises transmitting at least a portion of the plurality of likely attributes, attribute values, terms or any combination thereof for presentation as attribute suggestions, the attribute suggestions representing the plurality of likely attributes, attribute values, terms, any combination thereof, or any portion thereof that are transmitted for presentation being arranged in an order representing their respective calculated weights.

9. A method performed by a computing device having a processor and a memory for generating query formulation suggestions, the method comprising:

receiving a plurality of search queries from a query log, each of the plurality of search queries being associated with a respective set of matching entities;

identifying at least one semantic query pattern from the plurality of search queries;

identifying a weight for each identified semantic query pattern;

identifying a plurality of semantic categories from an entity database, each of the plurality of semantic categories being associated with a respective set of entities;

identifying at least one term commonly associated with at least one of the semantic categories;

identifying a plurality of semantic attributes as they pertain to the plurality of semantic categories;

identifying at least one semantic attribute pattern from the plurality of semantic attributes;

identifying a weight for each identified semantic attribute pattern; and

customizing a text-parser, at least in part, utilizing the at least one semantic query pattern and respective weights, the at least one semantic category term, and the at least one semantic attribute patterns and respective weights, the text-parser for use in parsing input user queries or portions thereof.

10. The method of claim **9**, wherein identifying at least one term commonly associated with at least one of the semantic categories comprises identifying at least one phrase commonly associated with at least one of the semantic categories.

11. The method of claim **9**, wherein identifying at least one term commonly associated with at least one of the semantic categories comprises identifying at least one n-gram commonly associated with at least one of the semantic categories.

12. The method of claim **9**, wherein the method further comprises:

receiving at least a portion of an input user search query;

applying the text-parser to determine at least one likely attribute, attribute value, term, or combination thereof for expansion of the input user query; and

transmitting the at least one likely attribute, attribute value, term, or combination thereof for presentation as an attribute suggestion.

13. The method of claim **12**, wherein applying the text-parser to determine at least one likely attribute, attribute value, term, or combination thereof for expansion of the input user query comprises applying the text-parser to determine a plurality of likely attributes, attribute values, terms, or any combination thereof for expansion of the input user query, each of the plurality of likely attributes, attribute values, terms, or any combination thereof having a calculated weight associated therewith.

14. The method of claim **13**, wherein transmitting the at least one likely attribute, attribute value, term, or combination thereof for presentation as an attribute suggestion comprises transmitting at least a portion of the plurality of likely attributes, attribute values, terms or any combination thereof for presentation as attribute suggestions, the attribute suggestions representing the plurality of likely attributes, attribute values, terms, any combination thereof, or any portion thereof that are transmitted for presentation being arranged in an order representing their respective calculated weights.

15. One or more computer-storage media storing computer-useable instructions that, when used by a computing device, cause the computing device to perform a method for ordering query formulation suggestions, the method comprising:

receiving a plurality of search queries from a query log, each of the plurality of search queries being associated with a respective set of matching entities;

identifying at least one semantic query pattern from the plurality of search queries;

identifying a weight for each identified semantic query pattern;

identifying a plurality of semantic categories from an entity database, each of the plurality of semantic categories being associated with a respective set of entities;

identifying at least one term commonly associated with at least one of the semantic categories;

identifying a plurality of semantic attributes as they pertain to the plurality of semantic categories;

identifying at least one semantic attribute pattern from the plurality of semantic attributes;

identifying a weight for each identified semantic attribute pattern;

customizing a text-parser, at least in part, utilizing the at least one semantic query pattern and respective weights, the at least one semantic category term, and the at least one semantic attribute patterns and respective weights, the text parser for use in parsing input user queries or portions thereof;

receiving at least a portion of an input user search query;

applying the text-parser to determine at least one likely attribute, attribute value, term, or combination thereof for expansion of the input user query; and

transmitting the at least one likely attribute, attribute value, term, or combination thereof for presentation as an attribute suggestion, the attribute suggestions representing the plurality of likely attributes, attribute values, terms, any combination thereof, or any portion thereof that are transmitted for presentation being arranged in an order representing their respective calculated weights.

16. The one or more computer-storage media of claim **15**, wherein identifying at least one term commonly associated with at least one of the semantic categories comprises identifying at least one phrase commonly associated with at least one of the semantic categories.

17. The one or more computer-storage media of claim **15**, wherein identifying at least one term commonly associated with at least one of the semantic categories comprises identifying at least one n-gram commonly associated with at least one of the semantic categories.

18. The one or more computer-storage media of claim **15**, wherein applying the text-parser to determine at least one likely attribute, attribute value, term, or combination thereof for expansion of the input user query comprises applying the text-parser to determine a plurality of likely attributes, attribute values, terms, or any combination thereof for expansion of the input user query, each of the plurality of likely attributes, attribute values, terms, or any combination thereof having a calculated weight associated therewith.

19. The one or more computer-storage media of claim **15**, wherein transmitting the at least one likely attribute, attribute value, term, or combination thereof for presentation as an attribute suggestion comprises transmitting at least a portion of the plurality of likely attributes, attribute values, terms or any combination thereof for presentation as attribute suggestions, the attribute suggestions representing the plurality of likely attributes, attribute values, terms, any combination thereof, or any portion thereof that are transmitted for presentation being arranged in an order representing their respective calculated weights.

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