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(54) **SYSTEMS AND METHODS TO IDENTIFY OBJECTIONABLE CONTENT**

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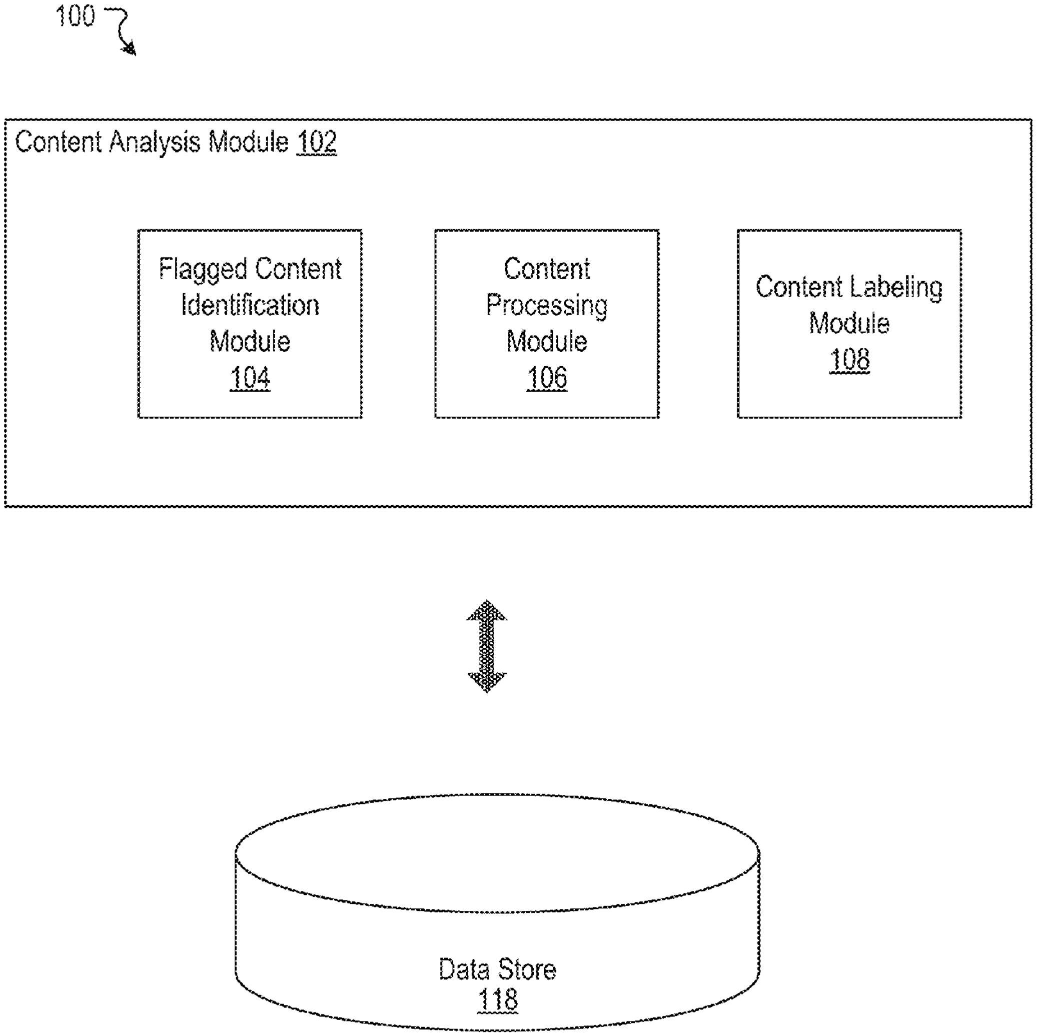
(57) **ABSTRACT**

Systems, methods, and non-transitory computer readable media configured to determine scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items. The scores can be associated with probabilities that the content items include objectionable material. A subset of the content items can be selected based on scores of the subset of the content items and satisfaction of a threshold value. It can be determined whether the subset of the content items includes objectionable material.


100
Content Analysis Module 102
Flagged Content Identification Module 104
Content Processing Module 106
Content Labeling Module 108
Data Store 118

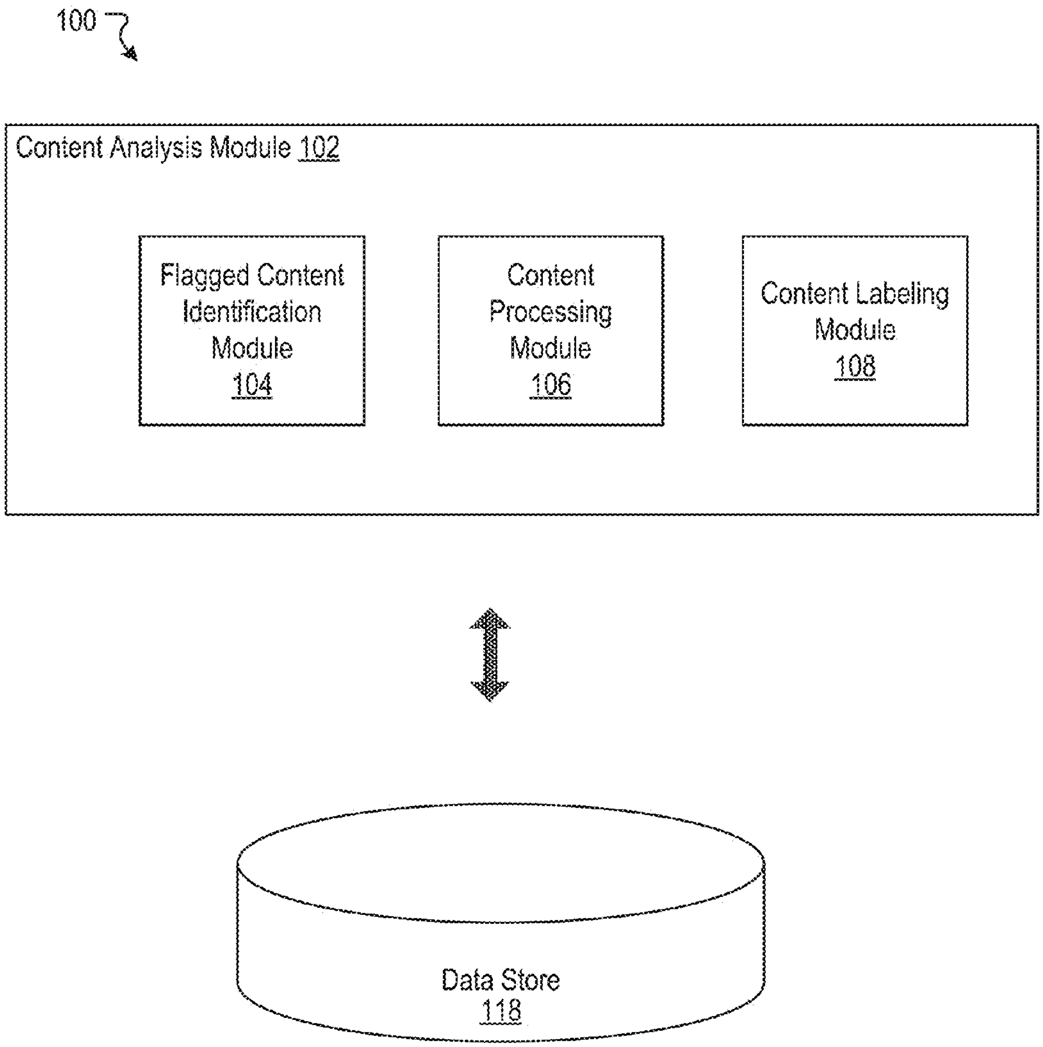

100
Content Analysis Module 102
Flagged Content Identification Module 104
Content Processing Module 106
Content Labeling Module 108
Data Store 118

FIGURE 1

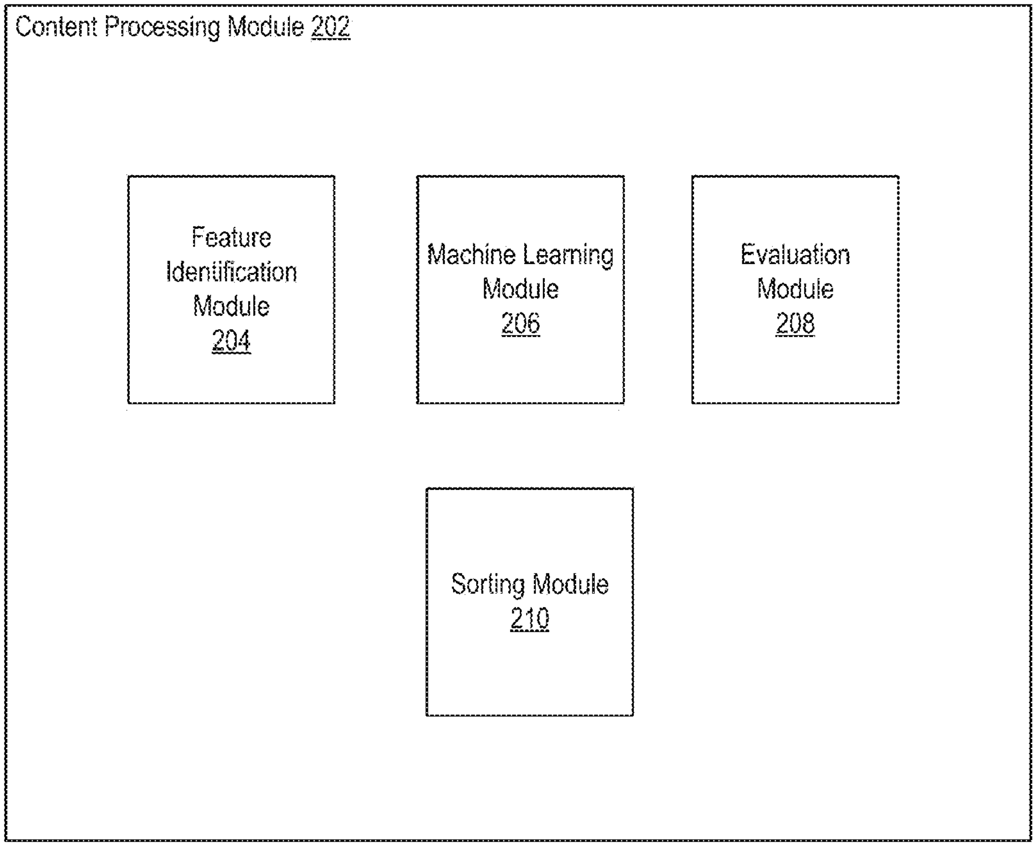

Content Processing Module 202
Feature Identification Module 204
Machine Learning Module 206
Evaluation Module 208
Sorting Module 210

FIGURE 2

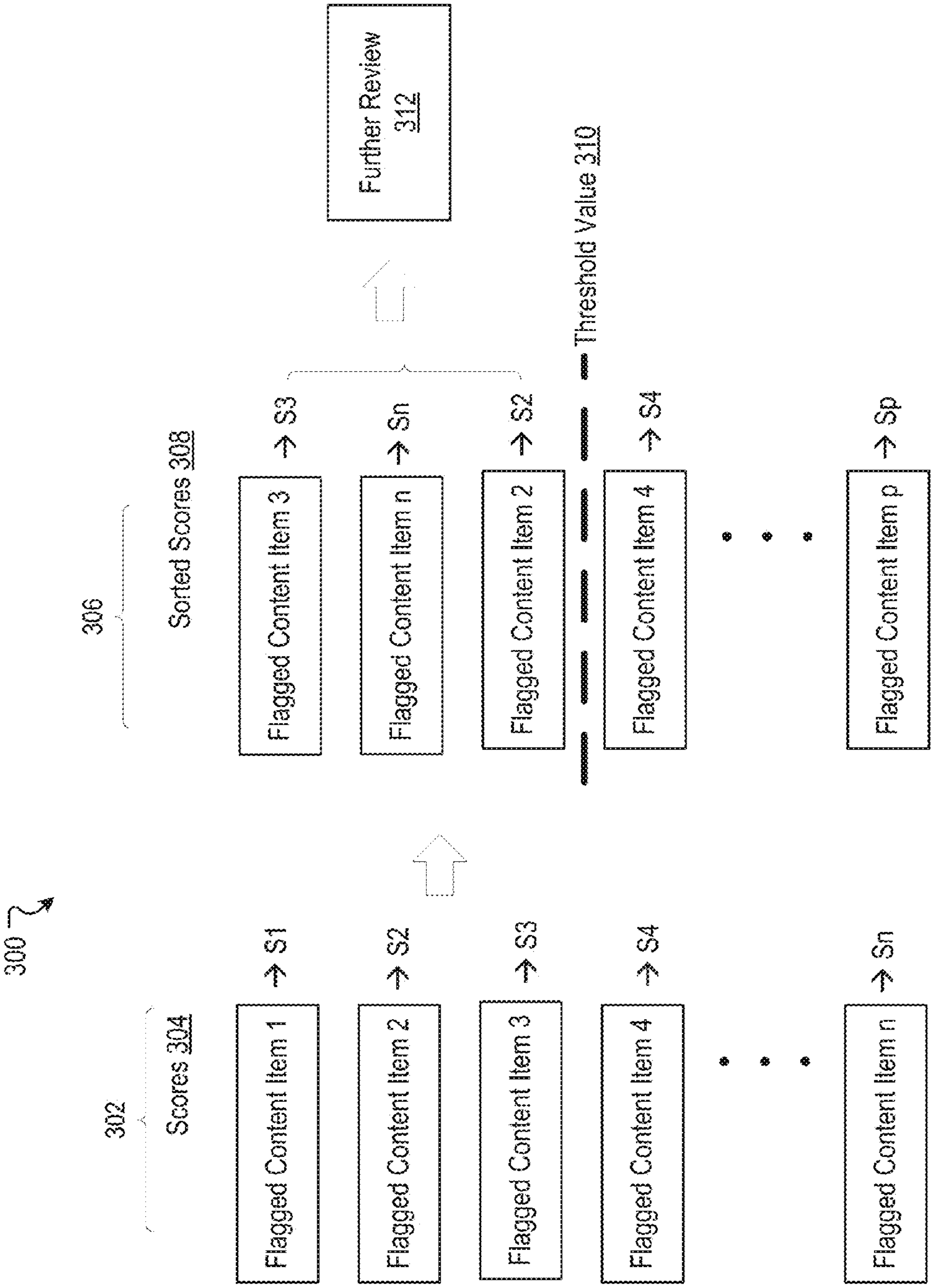

300
302
Scores 304
Flagged Content Item 1
→ S1
Flagged Content Item 2
→ S2
Flagged Content Item 3
→ S3
Flagged Content Item 4
→ S4
Flagged Content Item n
→ Sn
306
Sorted Scores 308
Flagged Content Item 3
→ S3
Flagged Content Item n
→ Sn
Flagged Content Item 2
→ S2
Threshold Value 310
Flagged Content Item 4
→ S4
Flagged Content Item p
→ Sp
Further Review
312

FIGURE 3

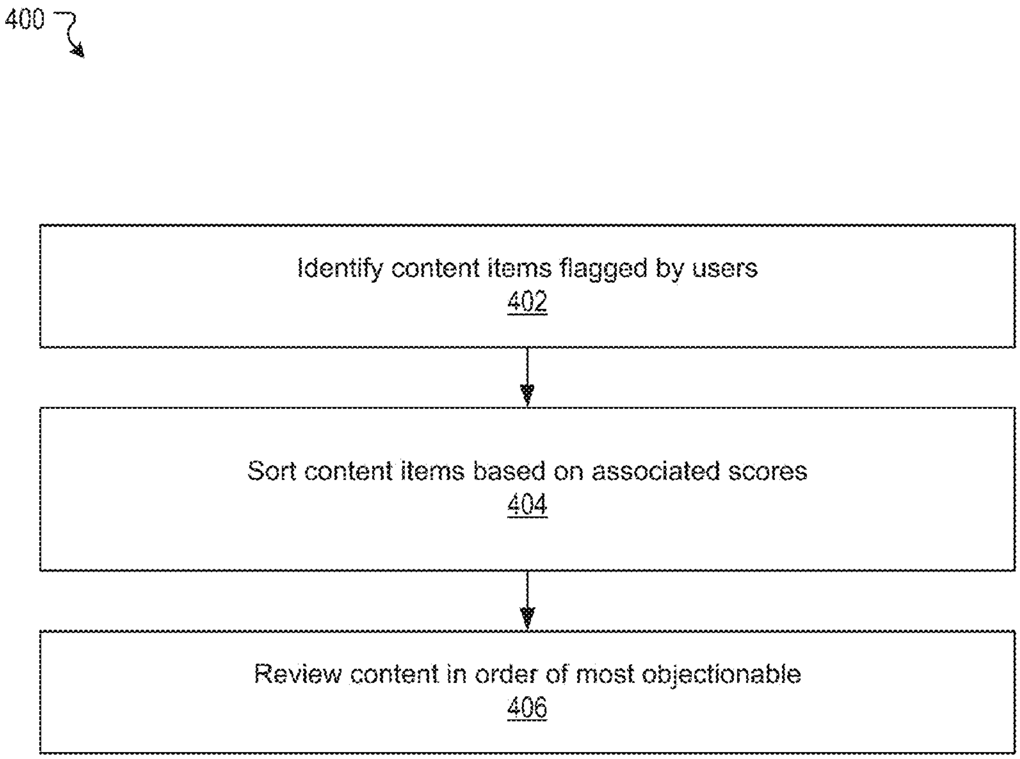

400
Identify content items flagged by users
402
Sort content items based on associated scores
404
Review content in order of most objectionable
406

FIGURE 4

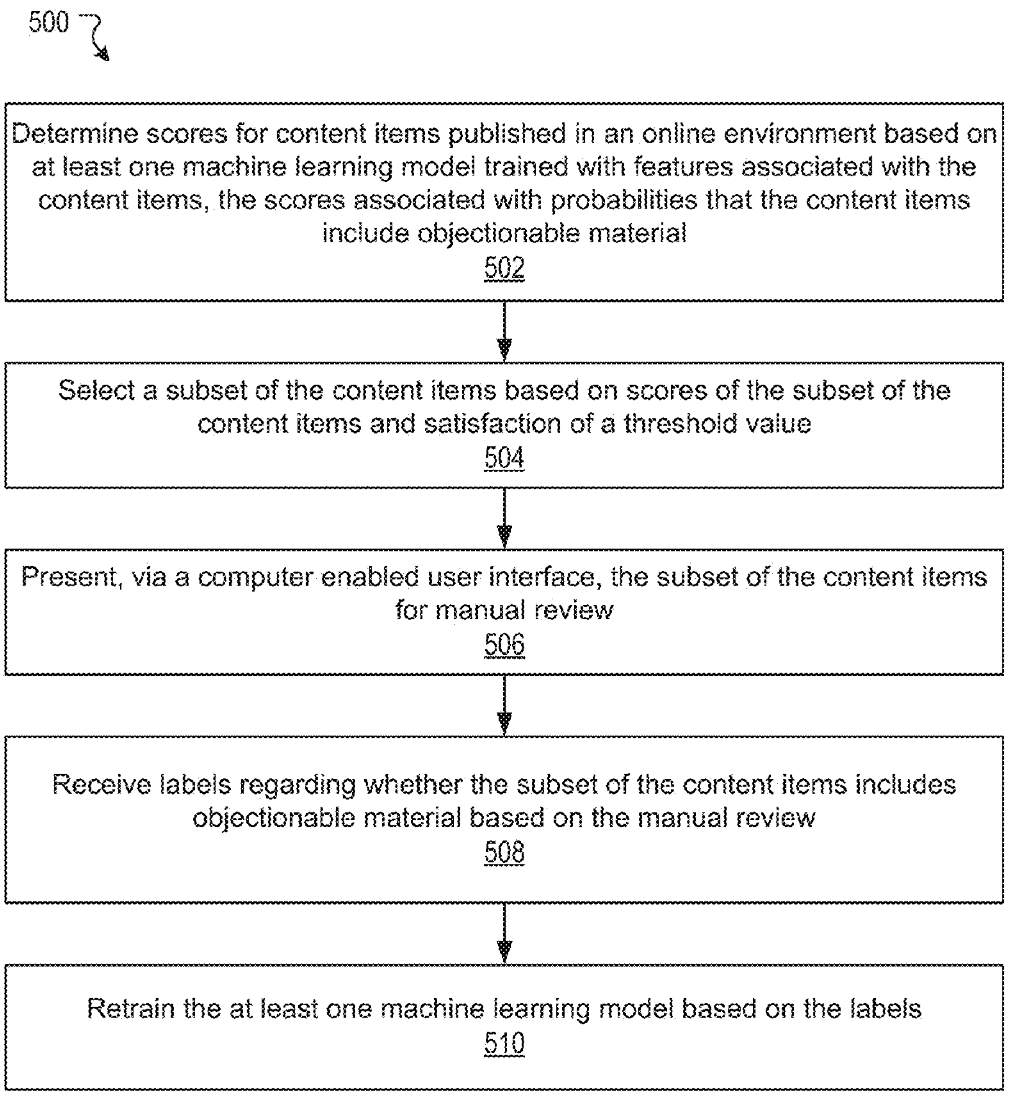

500
Determine scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items, the scores associated with probabilities that the content items include objectionable material
502
Select a subset of the content items based on scores of the subset of the content items and satisfaction of a threshold value
504
Present, via a computer enabled user interface, the subset of the content items for manual review
506
Receive labels regarding whether the subset of the content items includes objectionable material based on the manual review
508
Retrain the at least one machine learning model based on the labels
510

FIGURE 5

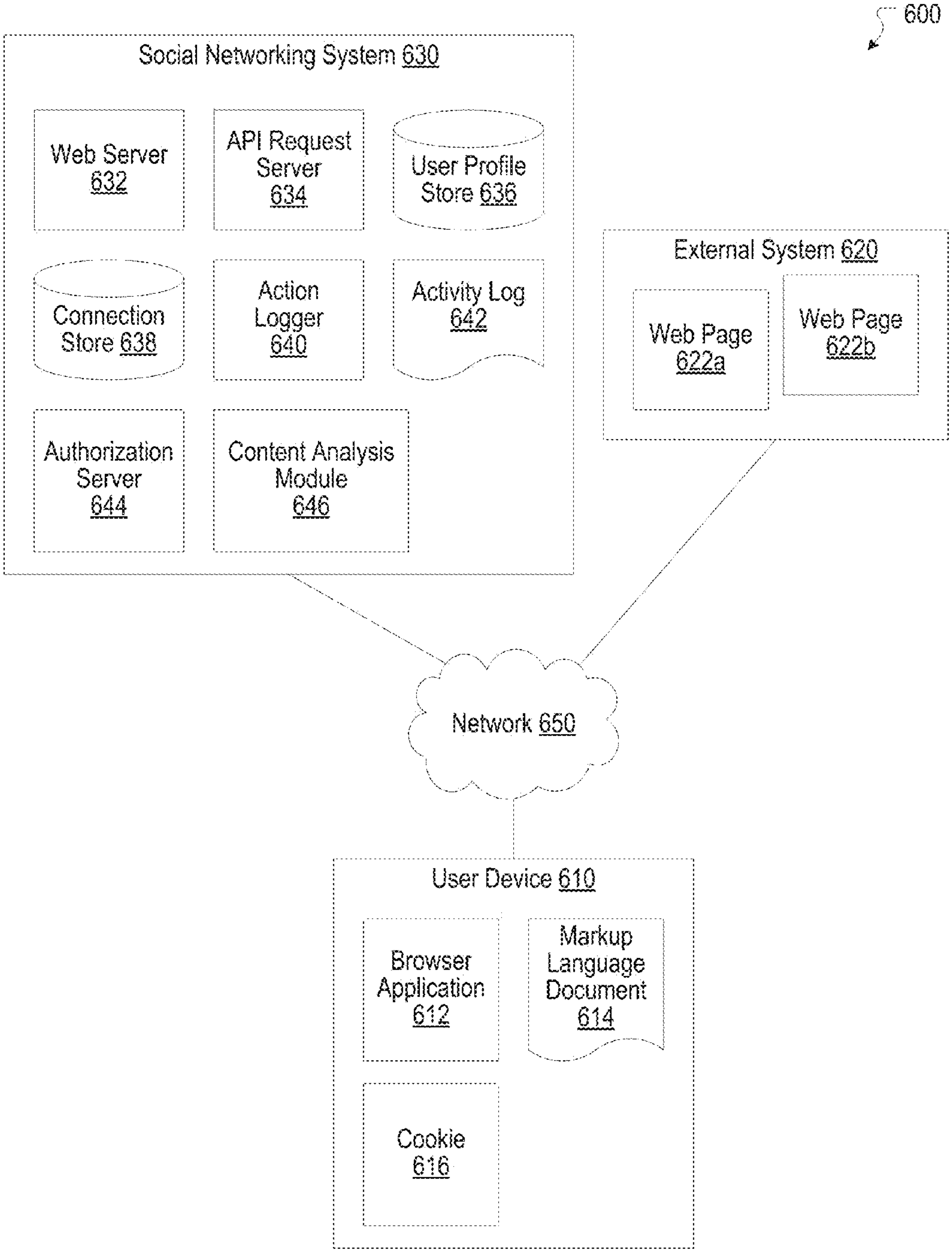

600
Social Networking System 630
Web Server 632
API Request Server 634
User Profile Store 636
Connection Store 638
Action Logger 640
Activity Log 642
Authorization Server 644
Content Analysis Module 646
External System 620
Web Page 622a
Web Page 622b
Network 650
User Device 610
Browser Application 612
Markup Language Document 614
Cookie 616

FIGURE 6

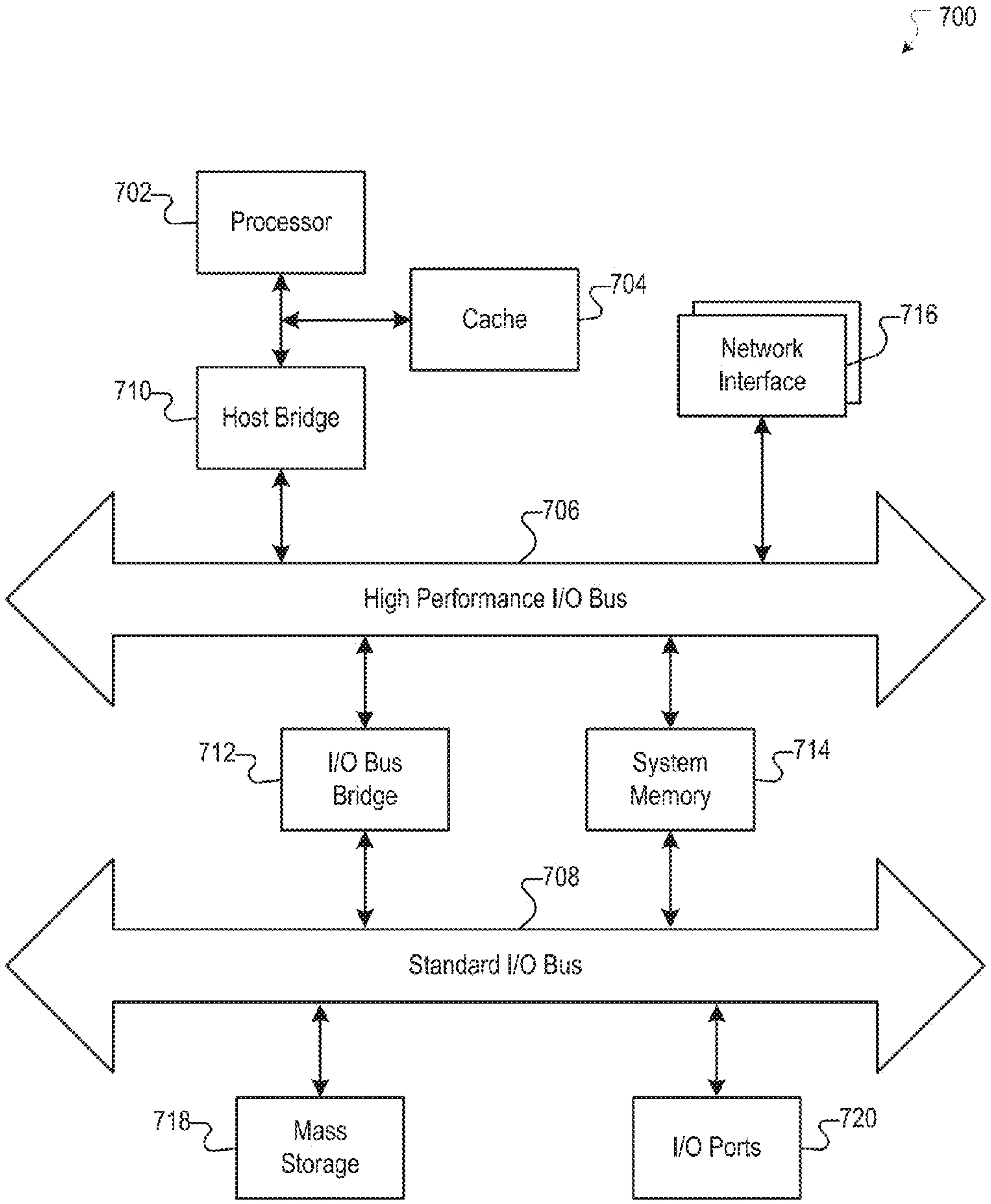

700
702
Processor
704
Cache
716
Network Interface
710
Host Bridge
706
High Performance I/O Bus
712
I/O Bus Bridge
System Memory
714
708
Standard I/O Bus
718
Mass Storage
I/O Ports
720

FIGURE 7

SYSTEMS AND METHODS TO IDENTIFY OBJECTIONABLE CONTENT

FIELD OF THE INVENTION

[0001] The present technology relates to the field of content identification. More particularly, the present technology relates to techniques for identifying objectionable content published in an online environment and marked for review.

BACKGROUND

[0002] Today, people often utilize computing devices for a wide variety of purposes. Users can use their computing devices, for example, to communicate and otherwise interact with other users. Such interactions are increasingly popular over a social network.

[0003] Some interactions in a social network may include the sharing of content. Content can take a variety of forms. For example, content can include publication of text, images, video, or a combination thereof to a selected audience of the social network. In particular, content can include, for example, images uploaded by a user, images uploaded by others in the social network of the user, descriptions of activities of connections of the user, articles regarding subject matter of interest to the user, advertisements directed to the user, etc. Content unfortunately also can include objectionable material that degrades user experience and otherwise compromises the spirit of and goodwill in productive communication within the social network.

SUMMARY

[0004] Various embodiments of the present disclosure can include systems, methods, and non-transitory computer readable media configured to determine scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items. The scores can be associated with probabilities that the content items include objectionable material. A subset of the content items can be selected based on scores of the subset of the content items and satisfaction of a threshold value. It can be determined whether the subset of the content items includes objectionable material.

[0005] In an embodiment, the features reflect contextual information regarding the content items.

[0006] In an embodiment, the features relate to at least one of a user who flagged a content item and a user who uploaded a flagged content item.

[0007] In an embodiment, the features include at least one of reporting accuracy, abuse history, gender, age, profile completeness, profile verification, locale, friends counts, account age, number of reporters, language, and topics reflected by the content items.

[0008] In an embodiment, the content items include flagged content items.

[0009] In an embodiment, the at least one machine learning model is based on a random forest technique.

[0010] In an embodiment, the at least one machine learning model includes different machine learning models. The different machine learning models are developed to identify objectionable material in different types of content items.

[0011] In an embodiment, the content items are sorted based on the scores.

[0012] In an embodiment, the determination of whether the subset of the content items includes objectionable material comprises presenting, via a computer enabled user interface, the subset of the content items for manual review. Labels regarding whether the subset of the content items includes objectionable material are received based on the manual review.

[0013] In an embodiment, the at least one machine learning model can be retrained based on the labels.

[0014] It should be appreciated that many other features, applications, embodiments, and/or variations of the disclosed technology will be apparent from the accompanying drawings and from the following detailed description. Additional and/or alternative implementations of the structures, systems, non-transitory computer readable media, and methods described herein can be employed without departing from the principles of the disclosed technology.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** illustrates a system including an example content analysis module, according to an embodiment of the present disclosure.

[0016] FIG. **2** illustrates an example content processing module, according to an embodiment of the present disclosure.

[0017] FIG. **3** illustrates an example functional diagram, according to an embodiment of the present disclosure.

[0018] FIG. **4** illustrates an example first method to allow review of flagged content items that may include objectionable material, according to an embodiment of the present disclosure.

[0019] FIG. **5** illustrates an example second method to allow review of flagged content items that may include objectionable material, according to an embodiment of the present disclosure.

[0020] FIG. **6** illustrates a network diagram of an example system that can be utilized in various scenarios, according to an embodiment of the present disclosure.

[0021] FIG. **7** illustrates an example of a computer system that can be utilized in various scenarios, according to an embodiment of the present disclosure.

[0022] The figures depict various embodiments of the disclosed technology for purposes of illustration only, wherein the figures use like reference numerals to identify like elements. One skilled in the art will readily recognize from the following discussion that alternative embodiments of the structures and methods illustrated in the figures can be employed without departing from the principles of the disclosed technology described herein.

DETAILED DESCRIPTION

Identifying Objectionable Content

[0023] People can use social networking systems (or services) for various purposes. Users of a social networking system can utilize their computing devices (or systems) to establish connections, communicate, and interact with one another via the social networking system. Users can also provide, create, edit, share, or access content such as images, videos, audio, articles, links, and text. In one example, a particular user of the social networking service can post or publish content items, which can be presented on a page (e.g., profile, timeline, wall, etc.) of the user. Other users, for example, can access, view, or interact with such content items published on the page of the user in accordance with privacy settings or preferences selected by the user. In another example, content items published or posted by the user can be surfaced to other users via news feeds associated with the other users.

[0024] Some content items published to a social networking system can include objectionable material. Objectionable material in content items can include pornography, hate speech, bullying, and the like. To identity objectionable material in content items, a social networking system can provide a computer enabled user interface with functionality to allow a user who accessed a content item to flag the content item to indicate her disapproval of the content item based on her belief that it contains objectionable material. The social networking system can monitor the content items that have received one or more flags and then provide such content items for manual review by administrators associated with the social networking system.

[0025] As the size of the social networking system grows, the engagement level of its users rises, and the number of content items published within the social networking system increases, administrators can be called upon to review in a relatively short time an immense number of content items that have been flagged. The scale of the review can unduly burden administrators and produce delays that frustrate prompt review and potential takedown of content items including objectionable material. As a result, proliferation of content items including objectionable material within the social networking system can impact the integrity and reputation of the social networking system.

[0026] An improved approach to identifying flagged content items including objectionable material overcomes disadvantages associated with conventional approaches. In general, systems, methods, and computer readable media of the present disclosure can identify content items that have been flagged by one or more users of a social networking system or other online environment. Features associated the flagged content items can be identified. In a training phase, a machine learning algorithm can develop a machine learning model for determining a probability that a flagged content item includes objectionable material based on the features and their values. In some instances, a plurality of models can be developed to better analyze various types of flagged content items. Each model can be trained using determinations resulting from manual review by administrators associated with the social networking system regarding whether content items include objectionable material or not. In an evaluation phase, a score associated with a flagged content item that indicates a probability that the content item includes objectionable material can be determined based on the model. Flagged content items can be sorted and ranked according to their scores. A flagged content item that satisfies one or more thresholds can be provided for manual review by administrators of the social networking system and a determination regarding whether the flagged content item includes objectionable material. In this manner, only flagged content items satisfying a threshold value relating to a probability of containing objectionable material are provided for manual review, increasing efficiencies in the identification and remediation of flagged content items within the social networking system.

[0027] FIG. **1** illustrates an example system **100** including an example content analysis module **102** to identify and redress content items having undesirable, improper, or otherwise objectionable material within a social networking system or other online environment, according to an embodiment of the present disclosure. A content item from which objectionable material can be identified by the content analysis module **102** can include text, images, video, audio, or the like, and any combination thereof. One type of objectionable material includes illegal, indecent, pornographic, illegitimate, inappropriate, hateful, or bullying information. In some embodiments, as discussed herein, the present disclosure can be used in connection with a social networking system that delivers content items to users of the social networking system. Other types of objectionable material can be defined in accordance with various standards provided by administrators of the social networking system, a community of the social networking system, legal regulations, etc.

[0028] The content analysis module **102** can include a flagged content identification module **104**, a content processing module **106**, and a content labeling module **108**. The components (e.g., modules, elements, steps, blocks, etc.) shown in this figure and all figures herein are exemplary only, and other implementations may include additional, fewer, integrated, or different components. Some components may not be shown so as not to obscure relevant details. In various embodiments, one or more of the functionalities described in connection with the content analysis module **102** can be implemented in any suitable combinations.

[0029] The flagged content identification module **104** can identify content items that have been flagged by users of a social networking system. Content items can be presented to users of the social networking system based on a computer generated user interface provided by the social networking system. The computer generated user interface may include functionality associated with a content item that allows a user to flag or otherwise register a belief that the content item includes objectionable material. The functionality may be implemented in a variety of manners, such as a button or other user input mechanism to allow a user to communicate an objection about a content item. The flagged content identification module **104** can monitor the flagging of content items by users and identify the content items that have been flagged. The flagged content identification module **104** can identify the flagged content items for the content processing module **106**.

[0030] In some embodiments, the flagged content identification module **104** can identify content items that have not been flagged in addition to or instead of content items that have been flagged. Content items that have not been flagged can be considered, processed, and analyzed in accordance with the principles and techniques described herein with respect to flagged content items.

[0031] The content processing module **106** can identify features associated with flagged content items. The features can include various attributes and other contextual information regarding the circumstances surrounding the flagged content item. In a training phase, the identified features can be used to develop a machine learning model to determine a score indicating a probability that a content item includes objectionable material. In some instances, a plurality of machine learning models can be developed to more optimally determine such scores for different types of content items. Each machine learning model can be trained and retrained using determinations about whether a flagged content item includes objectionable material or not based on manual review. Such manual review can be performed by one or more administrators of a social networking system. In an evaluation phase, when flagged content items are newly identified, the features of each flagged content item can be applied to the machine learning model to determine a score indicating a probability that the content item includes objectionable material. The flagged content items can be sorted and ranked according to their scores. A subset of the flagged content items associated with scores that satisfy a threshold value can be provided to the content labeling module **108**. The content processing module **106** is discussed in more detail herein.

[0032] The content labeling module **108** can facilitate labeling by one or more administrators of a social networking system of the subset of the flagged content items associated with scores that satisfy a threshold value regarding a probability that a flagged content item includes objectionable material. In some embodiments, the content labeling module **108** can present the subset of flagged content items to an administrator of the social networking system using a computer generated user interface. The flagged content items presented to the administrator can reflect any suitable ordering, such as an ordering in a descending manner such that the flagged content items having higher scores and higher probabilities of including objectionable material are presented first. Presentation of the subset of flagged content items as opposed to all flagged content items in this manner can relieve the administrator from the burden of having to manually review all flagged content items. In some embodiments, the score associated with the flagged content item and determined by the machine learning model can be presented alongside with or adjacent to the flagged content item in the computer generated user interface to further inform the manual review by the administrator.

[0033] The content labeling module **108** can cause the computer generated user interface to include a prompt for the administrator to label the flagged content item as including objectionable material or not in accordance with manual review by the administrator. The computer generated user interface can provide a suitable user input mechanism to receive a label provided by the administrator in this regard. After a flagged content item is labeled, the social networking system can take appropriate responsive action. For example, a flagged content item that is labeled as including objectionable material can be remediated by the social networking system in a variety of manners, such as removal. As another example, a flagged content item that is labeled as not including objectionable material can be left intact for continued potential access by other users of the social networking system. In addition, labeling of a flagged content item can be used to retrain machine learning models for determining a probability that a flagged content item includes objectionable material.

[0034] In some embodiments, the content labeling module **108** need not involve interaction with an administrator of a social networking system. When the machine learning models for determining the probability that flagged content items include objectionable material are deemed to be accurate to a desired level, the content labeling module **108** can label flagged content items based on the probabilities provided by the machine learning models without the need for manual review or other human intervention. For example, when a machine learning model exhibiting a desired level of accuracy produces a probability score for a flagged content item that satisfies a probability threshold, the content labeling module **108** can automatically label the flagged content item as including objectionable material.

[0035] The data store **118** can be configured to store and maintain various types of data, such as the data relating to support of and operation of the content analysis module **102**. The data can include data relating to, for example, flagged content items, features associated with one or more machine learning models to determine a probability that a flagged content item includes objectionable material, the machine learning models, determinations based on manual review regarding whether or not a flagged content items includes objectionable material, scores associated with flagged content items regarding the probability that the flagged content items include objectionable material, threshold values to select a subset of the flagged content items, etc. The data store **118** also can maintain other information associated with a social networking system. The information associated with the social networking system can include data about users, social connections, social interactions, locations, geo-fenced areas, maps, places, events, groups, posts, communications, content, account settings, privacy settings, and a social graph. The social graph can reflect all entities of the social networking system and their interactions. As shown in the example system **100**, the content analysis module **102** can be configured to communicate and/or operate with the data store **118**.

[0036] FIG. **2** illustrates an example content processing module **202**, according to an embodiment of the present disclosure. In some embodiments, the content processing module **106** of FIG. **1** can be implemented with the content processing module **202**. As shown in the example of FIG. **2**, the content processing module **202** can include a feature identification module **204**, a machine learning module **206**, an evaluation module **208**, and a sorting module **210**.

[0037] The feature identification module **204** can identify features and feature values associated with a flagged content item. In a training phase, the features can be used to develop a machine learning model to determine a probability that the flagged content item includes objectionable material. The features can relate to a user who flagged a content item or a user who uploaded a flagged content item. The features also can include any type of content information, attribute information, or other contextual information directly or indirectly relating to a flagged content item. For example, features can include but are not limited to the following:

[0038] Reporting Accuracy. This feature relates to a level of accuracy associated with a user in relation to other content items previously flagged by the user. The level of accuracy can be based on an amount of content items previously flagged by the user that were ultimately determined to include objectionable material.

[0039] Abuse History. This feature relates to a level of abuse associated with a user in relation to other content items previously uploaded by the user. The level of abuse can be based on an amount of content items previously uploaded by the user that were ultimately determined to include objectionable material.

[0040] Gender. This feature relates to gender of the user.

[0041] Age. This feature relates to age of the user.

[0042] Profile Completeness. This feature relates to whether fields of profile information have been provided by a user of a social networking system to the social networking system. Such profile information associated with the user can include, for example, name, user name, gender, age, marital status, email address, phone number, residential address, payment credentials, etc.

[0043] Profile Verification. This feature relates to whether profile information or the identity of a user has been verified.

[0044] Locale. This feature relates to the location of a user. The location of the user can include, for example, residential address, business address, temporary address, etc.

[0045] Friends Counts. This feature relates to a number of other users with whom a user is connected in a social networking system.

[0046] Account Age. This feature relates to a time duration during which a user has had an account with a social networking system.

[0047] Number of Reporters. This feature relates to a number of users who have flagged a particular content item.

[0048] Language. This feature relates to a language used by a user in connection with a flagged content item. The language can be the language used by the user or the language used in a flagged content item. In addition, the language can be the language used in a computer generated interface presented to the user.

[0049] Additional features can relate to contextual information about a flagged content item. For example, one or more features can relate to topics (or subject matter) reflected by a flagged content item. In some embodiments, the feature identification module **204** can include a content classification module (not shown) to identify topics as features. The content classification module can perform classification analyses on flagged content items, including, for example, images and text, based on any suitable processing techniques.

[0050] For example, with respect to images, an image classification module can perform a classification analysis on one or more images of a flagged content item to determine the topics reflected by the images. The image classification module can perform the classification analysis by applying a machine learning model (image classifier) to an image to determine probabilities that the image reflects predetermined topics. The image classifier can be based on any machine learning technique, including but not limited to a deep convolutional neural network. In a development phase, contextual cues for a sample set of images can be gathered. Images classes corresponding to various topics can be determined. Correlation of the sample set of images with the image classes based on the contextual cues can be determined. A training set of images can be generated from the sample set of images based on scores indicative of high correlation. The training set of images can be used to train the image classifier to generate visual pattern templates of the image classes. In an evaluation phase, the image classifier can be applied to one or more images of a new flagged content item to determine the topics reflected by the images.

[0051] As another example, with respect to text, topic tagging can use contextual information surrounding a flagged content item to determine topics reflected by the flagged content item. The contextual information can include, for example, the identities and profiles of users who interact with the flagged content item, affinities of the users, comments provided in relation to the flagged content item, etc. The contextual information can be used to infer topics reflected by the flagged content item. Other suitable techniques to determine topics reflected by flagged content items can be used. The feature identification module **204** can identify the determined topics as features.

[0052] Other contextual information can be used as features. For example, a determination that a flagged content item includes or does not include objectionable material can depend on a feature relating to a relationship between two or more of the following considerations: a user that uploaded the flagged content item, a user that flagged the content item, the flagged content item, and a topic reflected by the flagged content item. For instance, if the flagged content item includes an image of an unclothed baby, then the presence of objectionable material may be more likely when the uploader of the flagged content item is not a family relative or another connection of the baby. Similarly, if the flagged content item includes an image of an unclothed baby, then the presence of objectionable material may be less likely when the uploader of the flagged content item is a family relative or other connection of the baby.

[0053] Each feature can be associated with a feature value. For example, a feature value can include a numerical value to indicate a quantitative degree to which the associated feature may apply. As another example, a feature value can include a Boolean value to indicate the presence or absence of information relating to the associated feature. As yet another example, the feature value can include a string value to denote information relating to the associated feature.

[0054] The machine learning module **206** can develop a machine learning model (or classifier) to determine the probability that flagged content items include objectionable material. The machine learning model can be based on the features and associated feature values identified by the feature identification module **204**. In a supervised learning process, the machine learning module **206** can use determinations resulting from manual review by administrators associated with a social networking system regarding whether flagged content items include objectionable material. The machine learning module **206** can use the determinations resulting from manual review to train and retrain the machine learning model. In some embodiments, the machine learning model can be based on a random forest technique. In other embodiments, the machine learning model can be based on other machine learning techniques.

[0055] The machine learning module **206** can periodically or continuously retrain the machine learning model. Retraining of the machine learning model can refine the ability of the machine learning model to accurately determine the probability that a flagged content item includes objectionable material. The machine learning module **206** can retrain the machine learning model based on subsequent determinations resulting from manual review by administrators associated with a social networking system regarding whether flagged content items include objectionable material. As more determinations resulting from manual review regarding the presence of objectionable material in flagged content items are made, the determinations can be provided to the machine learning module **206** to further retrain the machine learning model. Retraining of the machine learning model in this manner can result in optimized precision scores, recall scores, and AUC in relation to the identification of flagged content items including objectionable material.

[0056] The machine learning module **206** can develop one or more machine learning models to determine the probability of flagged content items including objectionable material. In some embodiments, the machine learning module **206** can develop different machine learning models to identify objectionable material in different types of flagged content items. For example, the machine learning module **206** can develop a first machine learning model for flagged content items including text, a second machine learning model for flagged content items including an image, a third machine learning model for flagged content items including video, a fourth machine learning model for flagged content items including a combination of text and an image, a fifth machine learning model for flagged content items including a combination of text and video, and so on. In some embodiments, machine learning module **206** can develop different machine learning models to identify objectionable material in flagged content items based on different features. For example, the machine learning module **206** can develop a first machine learning model for flagged content items based on a first set of features and associated feature values. As another example, the machine learning module **206** can develop a second machine learning model for flagged content items based on a second set of features and associated feature values that is different from the first set.

[0057] The machine learning module **206** also can perform feature selection in some embodiments. The machine learning module **206** can select a subset of features identified by the feature identification module **204** to develop a machine learning model. The machine learning module **206** can perform feature selection to address data that contains redundant features, which provide no more information than other selected features, or irrelevant features, which provide no useful information.

[0058] The evaluation module **208** can determine in an evaluation phase a score indicating a probability that a flagged content item includes objectionable material. The determination of the score can be based on a machine learning model developed by the machine learning module **206**. When content items are flagged by users of a social networking system, the flagged content items can be provided to the evaluation module **208**. For each flagged content item, the evaluation module **208** can determine a score indicating a probability that the flagged content item includes objectionable material based on the machine learning model. In some embodiments, a score can have a value between 0 and 1, with the value of 1 indicating a highest probability that the flagged content item includes objectionable material. In some embodiments, when different machine learning models have been developed by the machine learning module **206**, the evaluation module **208** can select a most relevant machine learning model from the different machine learning models to determine a score for a particular flagged content item.

[0059] The sorting module **210** can sort and rank the flagged content items based on their scores. The scores can be ranked in ascending or descending order. Flagged content items that satisfy a threshold value can be provided to the content labeling module **108**. The threshold value can be any suitable value. For example, the threshold value can be a selected number of flagged content items that have the highest score. As another example, the threshold value can be a selected absolute value between 0 and 1. The number of flagged content items provided to the content labeling module **108** can be tuned by varying the threshold value. The threshold value can be determined by an administrator of a social networking system. In some embodiments, a threshold value is not needed or not used, and some or all flagged content items can be periodically or continuously presented for further manual review in an order based on their scores.

[0060] FIG. **3** illustrates an example functional diagram **300** illustrating a selection of flagged content items for further review, according to an embodiment of the present disclosure. The functional diagram **300** includes a collection of flagged content items **302** that have been flagged by users of a social networking system. The functional diagram **300** includes flagged contents items Flagged Content Item **1**, Flagged Content Item **2**, Flagged Content Item **3**, Flagged Content Item **4**, and Flagged Content Item n. Any number of flagged content items can be considered.

[0061] In a training phase, one or more machine learning models can be developed based on features relating to contextual information associated with flagged content items. In an evaluation phase, scores **304** for the collection of flagged content items **302** can be determined. Each score for a flagged content item can be based on application of a machine learning model to the flagged content item. The score can indicate a probability that the flagged content item includes objectionable material. As shown, Flagged Content Item **1** has a score S**1**, Flagged Content Item **2** has a score S2, Flagged Content Item **3** has a score S3, Flagged Content Item **4** has a score S**4**, and Flagged Content Item n has a score Sn.

[0062] The collection of flagged content items **302** can be sorted based on the scores **304** to produce a sorted collection of flagged content items **306**. The sorted collection of flagged content items **306** and associated sorted scores **308** can reflect, for example, a descending order. As shown, the sorted collection of flagged content items **306** is sorted based on the scores **304** to reflect the following descending order: Flagged Content Item **3**, Flagged Content Item n, Flagged Content Item **2**, Flagged Content Item **4**, and Flagged Content Item p.

[0063] A predetermined threshold value **310** can be used to select a subset of the sorted collection of flagged content items **306**. As shown, the threshold value **310** appears between Flagged Content Item **2** and Flagged Content Item **4**. Satisfaction of the threshold value can identify, for example, a predetermined number of flagged content items having the highest scores or all flagged content items having scores that are greater than or equal to a preselected value. As shown, Flagged Content Item **3**, Flagged Content Item n, and Flagged Content Item **2** satisfy the threshold value **310**. As a result, Flagged Content Item **3**, Flagged Content Item n, and Flagged Content Item **2** can be provided for further review **312** to determine whether they include objectionable material. Further review can involve manual review by an administrator of a social networking system to make such determinations. Such determinations can be used to inform potential remedial measures, such as takedown. Such determinations also can be used to retrain machine learning models to refine their accuracy in determining the probability that flagged content items include objectionable material.

[0064] FIG. **4** illustrates an example first method **400** to allow review of flagged content items that may include objectionable material, according to an embodiment of the present disclosure. It should be appreciated that there can be additional, fewer, or alternative steps performed in similar or alternative orders, or in parallel, in accordance with the various embodiments discussed herein unless otherwise stated.

[0065] At block **402**, the method **400** can identify content items flagged by users. At block **404**, the method **400** can sort content items based on associated scores. The scores can be produced based on one more trained machine learning models for determining the probability that flagged content items include objectionable material. At block **406**, the method **400** can provide flagged content items for manual review according to their associated scores. The flagged content items associated with the highest scores most likely include objectionable material and therefore can be presented for manual review before other flagged content items having lower scores. Other suitable techniques that incorporate various features and embodiments of the present disclosure are possible.

[0066] FIG. **5** illustrates an example second method **500** to allow review of flagged content items that may include objectionable material, according to an embodiment of the present disclosure. It should be appreciated that there can be additional, fewer, or alternative steps performed in similar or alternative orders, or in parallel, in accordance with the various embodiments discussed herein unless otherwise stated.

[0067] At block **502**, the method **500** can determine scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items, the scores associated with probabilities that the content items include objectionable material. At block **504**, the method **500** can select a subset of the content items based on scores of the subset of the content items and satisfaction of a threshold value. At block **506**, the method **500** can present, via a computer enabled user interface, the subset of the content items for manual review. At block **508**, the method **500** can receive labels regarding whether the subset of the content items includes objectionable material based on the manual review. At block **510**, the method **500** can retrain the at least one machine learning model based on the labels. Other suitable techniques that incorporate various features and embodiments of the present disclosure are possible.

Social Networking System-Example Implementation

[0068] FIG. **6** illustrates a network diagram of an example system **600** that can be utilized in various scenarios, in accordance with an embodiment of the present disclosure. The system **600** includes one or more user devices **610**, one or more external systems **620**, a social networking system (or service) **630**, and a network **650**. In an embodiment, the social networking service, provider, and/or system discussed in connection with the embodiments described above may be implemented as the social networking system **630**. For purposes of illustration, the embodiment of the system **600**, shown by FIG. **6**, includes a single external system **620** and a single user device **610**. However, in other embodiments, the system **600** may include more user devices **610** and/or more external systems **620**. In certain embodiments, the social networking system **630** is operated by a social network provider, whereas the external systems **620** are separate from the social networking system **630** in that they may be operated by different entities. In various embodiments, however, the social networking system **630** and the external systems **620** operate in conjunction to provide social networking services to users (or members) of the social networking system **630**. In this sense, the social networking system **630** provides a platform or backbone, which other systems, such as external systems **620**, may use to provide social networking services and functionalities to users across the Internet.

[0069] The user device **610** comprises one or more computing devices that can receive input from a user and transmit and receive data via the network **650**. In one embodiment, the user device **610** is a conventional computer system executing, for example, a Microsoft Windows compatible operating system (OS), Apple OS X, and/or a Linux distribution. In another embodiment, the user device **610** can be a device having computer functionality, such as a smartphone, a tablet, a personal digital assistant (PDA), a mobile telephone, etc. The user device **610** is configured to communicate via the network **650**. The user device **610** can execute an application, for example, a browser application that allows a user of the user device **610** to interact with the social networking system **630**. In another embodiment, the user device **610** interacts with the social networking system **630** through an application programming interface (API) provided by the native operating system of the user device **610**, such as iOS and ANDROID. The user device **610** is configured to communicate with the external system **620** and the social networking system **630** via the network **650**, which may comprise any combination of local area and/or wide area networks, using wired and/or wireless communication systems.

[0070] In one embodiment, the network **650** uses standard communications technologies and protocols. Thus, the network **650** can include links using technologies such as Ethernet, 802.11, worldwide interoperability for microwave access (WiMAX), 3G, 4G, CDMA, GSM, LTE, digital subscriber line (DSL), etc. Similarly, the networking protocols used on the network **650** can include multiprotocol label switching (MPLS), transmission control protocol/Internet protocol (TCP/IP), User Datagram Protocol (UDP), hypertext transport protocol (HTTP), simple mail transfer protocol (SMTP), file transfer protocol (FTP), and the like. The data exchanged over the network **650** can be represented using technologies and/or formats including hypertext markup language (HTML) and extensible markup language (XML). In addition, all or some links can be encrypted using conventional encryption technologies such as secure sockets layer (SSL), transport layer security (TLS), and Internet Protocol security (IPsec).

[0071] In one embodiment, the user device **610** may display content from the external system **620** and/or from the social networking system **630** by processing a markup language document **614** received from the external system **620** and from the social networking system **630** using a browser application **612**. The markup language document **614** identifies content and one or more instructions describing formatting or presentation of the content. By executing the instructions included in the markup language document **614**, the browser application **612** displays the identified content using the format or presentation described by the markup language document **614**. For example, the markup language document **614** includes instructions for generating and displaying a web page having multiple frames that include text and/or image data retrieved from the external system **620** and the social networking system **630**. In various embodiments, the markup language document **614** comprises a data file including extensible markup language (XML) data, extensible hypertext markup language (XHTML) data, or other markup language data. Additionally, the markup language document **614** may include JavaScript Object Notation (JSON) data, JSON with padding (JSONP), and JavaScript data to facilitate data-interchange between the external system **620** and the user device **610**. The browser application **612** on the user device **610** may use a JavaScript compiler to decode the markup language document **614**.

[0072] The markup language document **614** may also include, or link to, applications or application frameworks such as FLASH™ or Unity™ applications, the SilverLight™ application framework, etc.

[0073] In one embodiment, the user device **610** also includes one or more cookies **616** including data indicating whether a user of the user device **610** is logged into the social networking system **630**, which may enable modification of the data communicated from the social networking system **630** to the user device **610**.

[0074] The external system **620** includes one or more web servers that include one or more web pages **622***a*, **622***b*, which are communicated to the user device **610** using the network **650**. The external system **620** is separate from the social networking system **630**. For example, the external system **620** is associated with a first domain, while the social networking system **630** is associated with a separate social networking domain. Web pages **622***a*, **622***b*, included in the external system **620**, comprise markup language documents **614** identifying content and including instructions specifying formatting or presentation of the identified content.

[0075] The social networking system **630** includes one or more computing devices for a social network, including a plurality of users, and providing users of the social network with the ability to communicate and interact with other users of the social network. In some instances, the social network can be represented by a graph, i.e., a data structure including edges and nodes. Other data structures can also be used to represent the social network, including but not limited to databases, objects, classes, meta elements, files, or any other data structure. The social networking system **630** may be administered, managed, or controlled by an operator. The operator of the social networking system **630** may be a human being, an automated application, or a series of applications for managing content, regulating policies, and collecting usage metrics within the social networking system **630**. Any type of operator may be used.

[0076] Users may join the social networking system **630** and then add connections to any number of other users of the social networking system **630** to whom they desire to be connected. As used herein, the term "friend" refers to any other user of the social networking system **630** to whom a user has formed a connection, association, or relationship via the social networking system **630**. For example, in an embodiment, if users in the social networking system **630** are represented as nodes in the social graph, the term "friend" can refer to an edge formed between and directly connecting two user nodes.

[0077] Connections may be added explicitly by a user or may be automatically created by the social networking system **630** based on common characteristics of the users (e.g., users who are alumni of the same educational institution). For example, a first user specifically selects a particular other user to be a friend. Connections in the social networking system **630** are usually in both directions, but need not be, so the terms "user" and "friend" depend on the frame of reference. Connections between users of the social networking system **630** are usually bilateral ("two-way"), or "mutual," but connections may also be unilateral, or "one-way." For example, if Bob and Joe are both users of the social networking system **630** and connected to each other, Bob and Joe are each other's connections. If, on the other hand, Bob wishes to connect to Joe to view data communicated to the social networking system **630** by Joe, but Joe does not wish to form a mutual connection, a unilateral connection may be established. The connection between users may be a direct connection; however, some embodiments of the social networking system **630** allow the connection to be indirect via one or more levels of connections or degrees of separation.

[0078] In addition to establishing and maintaining connections between users and allowing interactions between users, the social networking system **630** provides users with the ability to take actions on various types of items supported by the social networking system **630**. These items may include groups or networks (i.e., social networks of people, entities, and concepts) to which users of the social networking system **630** may belong, events or calendar entries in which a user might be interested, computer-based applications that a user may use via the social networking system **630**, transactions that allow users to buy or sell items via services provided by or through the social networking system **630**, and interactions with advertisements that a user may perform on or off the social networking system **630**. These are just a few examples of the items upon which a user may act on the social networking system **630**, and many others are possible. A user may interact with anything that is capable of being represented in the social networking system **630** or in the external system **620**, separate from the social networking system **630**, or coupled to the social networking system **630** via the network **650**.

[0079] The social networking system **630** is also capable of linking a variety of entities. For example, the social networking system **630** enables users to interact with each other as well as external systems **620** or other entities through an API, a web service, or other communication channels. The social networking system **630** generates and maintains the "social graph" comprising a plurality of nodes interconnected by a plurality of edges. Each node in the social graph may represent an entity that can act on another node and/or that can be acted on by another node. The social graph may include various types of nodes. Examples of types of nodes include users, non-person entities, content items, web pages, groups, activities, messages, concepts, and any other things that can be represented by an object in the social networking system **630**. An edge between two nodes in the social graph may represent a particular kind of connection, or association, between the two nodes, which may result from node relationships or from an action that was performed by one of the nodes on the other node. In some cases, the edges between nodes can be weighted. The weight of an edge can represent an attribute associated with the edge, such as a strength of the connection or association between nodes. Different types of edges can be provided with different weights. For example, an edge created when one user "likes" another user may be given one weight, while an edge created when a user befriends another user may be given a different weight.

[0080] As an example, when a first user identifies a second user as a friend, an edge in the social graph is generated connecting a node representing the first user and a second node representing the second user. As various nodes relate or interact with each other, the social networking system **630** modifies edges connecting the various nodes to reflect the relationships and interactions.

[0081] The social networking system **630** also includes user-generated content, which enhances a user's interactions with the social networking system **630**. User-generated content may include anything a user can add, upload, send, or "post" to the social networking system **630**. For example, a user communicates posts to the social networking system **630** from a user device **610**. Posts may include data such as status updates or other textual data, location information, images such as photos, videos, links, music or other similar data and/or media. Content may also be added to the social networking system **630** by a third party. Content "items" are represented as objects in the social networking system **630**. In this way, users of the social networking system **630** are encouraged to communicate with each other by posting text and content items of various types of media through various communication channels. Such communication increases the interaction of users with each other and increases the frequency with which users interact with the social networking system **630**.

[0082] The social networking system **630** includes a web server **632**, an API request server **634**, a user profile store **636**, a connection store **638**, an action logger **640**, an activity log **642**, and an authorization server **644**. In an embodiment of the invention, the social networking system **630** may include additional, fewer, or different components for various applications. Other components, such as network interfaces, security mechanisms, load balancers, failover servers, management and network operations consoles, and the like are not shown so as to not obscure the details of the system.

[0083] The user profile store **636** maintains information about user accounts, including biographic, demographic, and other types of descriptive information, such as work experience, educational history, hobbies or preferences, location, and the like that has been declared by users or inferred by the social networking system **630**. This information is stored in the user profile store **636** such that each user is uniquely identified. The social networking system **630** also stores data describing one or more connections between different users in the connection store **638**. The connection information may indicate users who have similar or common work experience, group memberships, hobbies, or educational history. Additionally, the social networking system **630** includes user-defined connections between different users, allowing users to specify their relationships with other users. For example, user-defined connections allow users to generate relationships with other users that parallel the users' real-life relationships, such as friends, co-workers, partners, and so forth. Users may select from predefined types of connections, or define their own connection types as needed. Connections with other nodes in the social networking system **630**, such as non-person entities, buckets, cluster centers, images, interests, pages, external systems, concepts, and the like are also stored in the connection store **638**.

[0084] The social networking system **630** maintains data about objects with which a user may interact. To maintain this data, the user profile store **636** and the connection store **638** store instances of the corresponding type of objects maintained by the social networking system **630**. Each object type has information fields that are suitable for storing information appropriate to the type of object. For example, the user profile store **636** contains data structures with fields suitable for describing a user's account and information related to a user's account. When a new object of a particular type is created, the social networking system **630** initializes a new data structure of the corresponding type, assigns a unique object identifier to it, and begins to add data to the object as needed. This might occur, for example, when a user becomes a user of the social networking system **630**, the social networking system **630** generates a new instance of a user profile in the user profile store **636**, assigns a unique identifier to the user account, and begins to populate the fields of the user account with information provided by the user.

[0085] The connection store **638** includes data structures suitable for describing a user's connections to other users, connections to external systems **620** or connections to other entities. The connection store **638** may also associate a connection type with a user's connections, which may be used in conjunction with the user's privacy setting to regulate access to information about the user. In an embodiment of the invention, the user profile store **636** and the connection store **638** may be implemented as a federated database.

[0086] Data stored in the connection store **638**, the user profile store **636**, and the activity log **642** enables the social networking system **630** to generate the social graph that uses nodes to identify various objects and edges connecting nodes to identify relationships between different objects. For example, if a first user establishes a connection with a second user in the social networking system **630**, user accounts of the first user and the second user from the user profile store **636** may act as nodes in the social graph. The connection between the first user and the second user stored by the connection store **638** is an edge between the nodes associated with the first user and the second user. Continuing this example, the second user may then send the first user a message within the social networking system **630**. The action of sending the message, which may be stored, is another edge between the two nodes in the social graph representing the first user and the second user. Additionally, the message itself may be identified and included in the social graph as another node connected to the nodes representing the first user and the second user.

[0087] In another example, a first user may tag a second user in an image that is maintained by the social networking system **630** (or, alternatively, in an image maintained by another system outside of the social networking system **630**). The image may itself be represented as a node in the social networking system **630**. This tagging action may create edges between the first user and the second user as well as create an edge between each of the users and the image, which is also a node in the social graph. In yet another example, if a user confirms attending an event, the user and the event are nodes obtained from the user profile store **636**, where the attendance of the event is an edge between the nodes that may be retrieved from the activity log **642**. By generating and maintaining the social graph, the social networking system **630** includes data describing many different types of objects and the interactions and connections among those objects, providing a rich source of socially relevant information.

[0088] The web server **632** links the social networking system **630** to one or more user devices **610** and/or one or more external systems **620** via the network **650**. The web server **632** serves web pages, as well as other web-related content, such as Java, JavaScript, Flash, XML, and so forth. The web server **632** may include a mail server or other messaging functionality for receiving and routing messages between the social networking system **630** and one or more user devices **610**. The messages can be instant messages, queued messages (e.g., email), text and SMS messages, or any other suitable messaging format.

[0089] The API request server **634** allows one or more external systems **620** and user devices **610** to call access information from the social networking system **630** by calling one or more API functions. The API request server **634** may also allow external systems **620** to send information to the social networking system **630** by calling APIs. The external system **620**, in one embodiment, sends an API request to the social networking system **630** via the network **650**, and the API request server **634** receives the API request. The API request server **634** processes the request by calling an API associated with the API request to generate an appropriate response, which the API request server **634** communicates to the external system **620** via the network **650**. For example, responsive to an API request, the API request server **634** collects data associated with a user, such as the user's connections that have logged into the external system **620**, and communicates the collected data to the external system **620**. In another embodiment, the user device **610** communicates with the social networking system **630** via APIs in the same manner as external systems **620**.

[0090] The action logger **640** is capable of receiving communications from the web server **632** about user actions on and/or off the social networking system **630**. The action logger **640** populates the activity log **642** with information about user actions, enabling the social networking system **630** to discover various actions taken by its users within the social networking system **630** and outside of the social networking system **630**. Any action that a particular user takes with respect to another node on the social networking system **630** may be associated with each user's account, through information maintained in the activity log **642** or in a similar database or other data repository. Examples of actions taken by a user within the social networking system **630** that are identified and stored may include, for example, adding a connection to another user, sending a message to another user, reading a message from another user, viewing content associated with another user, attending an event posted by another user, posting an image, attempting to post an image, or other actions interacting with another user or another object. When a user takes an action within the social networking system **630**, the action is recorded in the activity log **642**. In one embodiment, the social networking system **630** maintains the activity log **642** as a database of entries. When an action is taken within the social networking system **630**, an entry for the action is added to the activity log **642**. The activity log **642** may be referred to as an action log.

[0091] Additionally, user actions may be associated with concepts and actions that occur within an entity outside of the social networking system **630**, such as an external system **620** that is separate from the social networking system **630**. For example, the action logger **640** may receive data describing a user's interaction with an external system **620** from the web server **632**. In this example, the external system **620** reports a user's interaction according to structured actions and objects in the social graph.

[0092] Other examples of actions where a user interacts with an external system **620** include a user expressing an interest in an external system **620** or another entity, a user posting a comment to the social networking system **630** that discusses an external system **620** or a web page **622*a*** within the external system **620**, a user posting to the social networking system **630** a Uniform Resource Locator (URL) or other identifier associated with an external system **620**, a user attending an event associated with an external system **620**, or any other action by a user that is related to an external system **620**. Thus, the activity log **642** may include actions describing interactions between a user of the social networking system **630** and an external system **620** that is separate from the social networking system **630**.

[0093] The authorization server **644** enforces one or more privacy settings of the users of the social networking system **630**. A privacy setting of a user determines how particular information associated with a user can be shared. The privacy setting comprises the specification of particular information associated with a user and the specification of the entity or entities with whom the information can be shared. Examples of entities with which information can be shared may include other users, applications, external systems **620**, or any entity that can potentially access the information. The information that can be shared by a user comprises user account information, such as profile photos, phone numbers associated with the user, user's connections, actions taken by the user such as adding a connection, changing user profile information, and the like.

[0094] The privacy setting specification may be provided at different levels of granularity. For example, the privacy setting may identify specific information to be shared with other users; the privacy setting identifies a work phone number or a specific set of related information, such as, personal information including profile photo, home phone number, and status. Alternatively, the privacy setting may apply to all the information associated with the user. The specification of the set of entities that can access particular information can also be specified at various levels of granularity. Various sets of entities with which information can be shared may include, for example, all friends of the user, all friends of friends, all applications, or all external systems **620**. One embodiment allows the specification of the set of entities to comprise an enumeration of entities. For example, the user may provide a list of external systems **620** that are allowed to access certain information. Another embodiment allows the specification to comprise a set of entities along with exceptions that are not allowed to access the information. For example, a user may allow all external systems **620** to access the user's work information, but specify a list of external systems **620** that are not allowed to access the work information. Certain embodiments call the list of exceptions that are not allowed to access certain information a "block list". External systems **620** belonging to a block list specified by a user are blocked from accessing the information specified in the privacy setting. Various combinations of granularity of specification of information, and granularity of specification of entities, with which information is shared are possible. For example, all personal information may be shared with friends whereas all work information may be shared with friends of friends.

[0095] The authorization server **644** contains logic to determine if certain information associated with a user can be accessed by a user's friends, external systems **620**, and/or other applications and entities. The external system **620** may need authorization from the authorization server **644** to access the user's more private and sensitive information, such as the user's work phone number. Based on the user's privacy settings, the authorization server **644** determines if another user, the external system **620**, an application, or another entity is allowed to access information associated with the user, including information about actions taken by the user.

[0096] In some embodiments, the social networking system **630** can include a content analysis module **646**. The content analysis module **646** can be implemented with the content analysis module **102**, as discussed in more detail herein.

Hardware Implementation

[0097] The foregoing processes and features can be implemented by a wide variety of machine and computer system architectures and in a wide variety of network and computing environments. FIG. **7** illustrates an example of a computer system **700** that may be used to implement one or more of the embodiments described herein in accordance with an embodiment of the invention. The computer system **700** includes sets of instructions for causing the computer system **700** to perform the processes and features discussed herein. The computer system **700** may be connected (e.g., networked) to other machines. In a networked deployment, the computer system **700** may operate in the capacity of a server machine or a client machine in a client-server network environment, or as a peer machine in a peer-to-peer (or distributed) network environment. In an embodiment of the invention, the computer system **700** may be the social networking system **630**, the user device **610**, and the external system **720**, or a component thereof. In an embodiment of the invention, the computer system **700** may be one server among many that constitutes all or part of the social networking system **630**.

[0098] The computer system **700** includes a processor **702**, a cache **704**, and one or more executable modules and drivers, stored on a computer-readable medium, directed to the processes and features described herein. Additionally, the computer system **700** includes a high performance input/output (I/O) bus **706** and a standard I/O bus **708**. A host bridge **710** couples processor **702** to high performance I/O bus **706**, whereas I/O bus bridge **712** couples the two buses **706** and **708** to each other. A system memory **714** and one or more network interfaces **716** couple to high performance I/O bus **706**. The computer system **700** may further include video memory and a display device coupled to the video memory (not shown). Mass storage **718** and I/O ports **720** couple to the standard I/O bus **708**. The computer system **700** may optionally include a keyboard and pointing device, a display device, or other input/output devices (not shown) coupled to the standard I/O bus **708**. Collectively, these elements are intended to represent a broad category of computer hardware systems, including but not limited to computer systems based on the x86-compatible processors manufactured by Intel Corporation of Santa Clara, Calif., and the x86-compatible processors manufactured by Advanced Micro Devices (AMD), Inc., of Sunnyvale, Calif., as well as any other suitable processor.

[0099] An operating system manages and controls the operation of the computer system **700**, including the input and output of data to and from software applications (not shown). The operating system provides an interface between the software applications being executed on the system and the hardware components of the system. Any suitable operating system may be used, such as the LINUX Operating System, the Apple Macintosh Operating System, available from Apple Computer Inc. of Cupertino, Calif., UNIX operating systems, Microsoft® Windows® operating systems, BSD operating systems, and the like. Other implementations are possible.

[0100] The elements of the computer system **700** are described in greater detail below. In particular, the network interface **716** provides communication between the computer system **700** and any of a wide range of networks, such as an Ethernet (e.g., IEEE 802.3) network, a backplane, etc. The mass storage **718** provides permanent storage for the data and programming instructions to perform the above-described processes and features implemented by the respective computing systems identified above, whereas the system memory **714** (e.g., DRAM) provides temporary storage for the data and programming instructions when executed by the processor **702**. The I/O ports **720** may be one or more serial and/or parallel communication ports that provide communication between additional peripheral devices, which may be coupled to the computer system **700**.

[0101] The computer system **700** may include a variety of system architectures, and various components of the computer system **700** may be rearranged. For example, the cache **704** may be on-chip with processor **702**. Alternatively, the cache **704** and the processor **702** may be packed together as a "processor module", with processor **702** being referred to as the "processor core". Furthermore, certain embodiments of the invention may neither require nor include all of the above components. For example, peripheral devices coupled to the standard I/O bus **708** may couple to the high performance I/O bus **706**. In addition, in some embodiments, only a single bus may exist, with the components of the computer system **700** being coupled to the single bus. Moreover, the computer system **700** may include additional components, such as additional processors, storage devices, or memories.

[0102] In general, the processes and features described herein may be implemented as part of an operating system or a specific application, component, program, object, module, or series of instructions referred to as "programs". For example, one or more programs may be used to execute specific processes described herein. The programs typically comprise one or more instructions in various memory and storage devices in the computer system **700** that, when read and executed by one or more processors, cause the computer system **700** to perform operations to execute the processes and features described herein. The processes and features described herein may be implemented in software, firmware, hardware (e.g., an application specific integrated circuit), or any combination thereof.

[0103] In one implementation, the processes and features described herein are implemented as a series of executable modules run by the computer system **700**, individually or collectively in a distributed computing environment. The foregoing modules may be realized by hardware, executable modules stored on a computer-readable medium (or machine-readable medium), or a combination of both. For example, the modules may comprise a plurality or series of instructions to be executed by a processor in a hardware system, such as the processor **702**. Initially, the series of instructions may be stored on a storage device, such as the mass storage **718**. However, the series of instructions can be stored on any suitable computer readable storage medium. Furthermore, the series of instructions need not be stored locally, and could be received from a remote storage device, such as a server on a network, via the network interface **716**. The instructions are copied from the storage device, such as the mass storage **718**, into the system memory **714** and then accessed and executed by the processor **702**. In various implementations, a module or modules can be executed by a processor or multiple processors in one or multiple locations, such as multiple servers in a parallel processing environment.

[0104] Examples of computer-readable media include, but are not limited to, recordable type media such as volatile and non-volatile memory devices; solid state memories; floppy and other removable disks; hard disk drives; magnetic media; optical disks (e.g., Compact Disk Read-Only Memory (CD ROMS), Digital Versatile Disks (DVDs)); other similar non-transitory (or transitory), tangible (or non-tangible) storage medium; or any type of medium suitable for storing, encoding, or carrying a series of instructions for execution by the computer system **700** to perform any one or more of the processes and features described herein.

[0105] For purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the description. It will be apparent, however, to one skilled in the art that embodiments of the disclosure can be practiced without these specific details. In some instances, modules, structures, processes, features, and devices are shown in block diagram form in order to avoid obscuring the description. In other instances, functional block diagrams and flow diagrams are shown to represent data and logic flows. The components of block diagrams and flow diagrams (e.g., modules, blocks, structures, devices, features, etc.) may be variously combined, separated, removed, reordered, and replaced in a manner other than as expressly described and depicted herein.

[0106] Reference in this specification to “one embodiment”, “an embodiment”, “other embodiments”, “one series of embodiments”, “some embodiments”, “various embodiments”, or the like means that a particular feature, design, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of, for example, the phrase “in one embodiment” or “in an embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, whether or not there is express reference to an “embodiment” or the like, various features are described, which may be variously combined and included in some embodiments, but also variously omitted in other embodiments. Similarly, various features are described that may be preferences or requirements for some embodiments, but not other embodiments.

[0107] The language used herein has been principally selected for readability and instructional purposes, and it may not have been selected to delineate or circumscribe the inventive subject matter. It is therefore intended that the scope of the invention be limited not by this detailed description, but rather by any claims that issue on an application based hereon. Accordingly, the disclosure of the embodiments of the invention is intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

What is claimed is:

1. A computer-implemented method comprising:

determining, by a computing system, scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items, the scores associated with probabilities that the content items include objectionable material;

selecting, by the computing system, a subset of the content items based on scores of the subset of the content items and satisfaction of a threshold value; and

determining, by the computing system, whether the subset of the content items includes objectionable material.

2. The computer-implemented method of claim **1**, wherein the features reflect contextual information regarding the content items.

3. The computer-implemented method of claim **2**, wherein the features relate to at least one of a user who flagged a content item and a user who uploaded a flagged content item.

4. The computer-implemented method of claim **3**, wherein the features include at least one of reporting accuracy, abuse history, gender, age, profile completeness, profile verification, locale, friends counts, account age, number of reporters, language, and topics reflected by the content items.

5. The computer-implemented method of claim **1**, wherein the content items include flagged content items.

6. The computer-implemented method of claim **1**, wherein the at least one machine learning model is based on a random forest technique.

7. The computer-implemented method of claim **1**, wherein the at least one machine learning model includes different machine learning models, the method further comprising developing the different machine learning models to identify objectionable material in different types of content items.

8. The computer-implemented method of claim **1**, further comprising sorting the content items based on the scores.

9. The computer-implemented method of claim **1**, wherein the determining whether the subset of the content items includes objectionable material comprises:

presenting, via a computer enabled user interface, the subset of the content items for manual review; and

receiving labels regarding whether the subset of the content items includes objectionable material based on the manual review.

10. The computer-implemented method of claim **9**, further comprising retraining the at least one machine learning model based on the labels.

11. A system comprising:

at least one processor; and

a memory storing instructions that, when executed by the at least one processor, cause the system to perform:

determining scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items, the scores associated with probabilities that the content items include objectionable material;

selecting a subset of the content items based on scores of the subset of the content items and satisfaction of a threshold value; and determining whether the subset of the content items includes objectionable material.

12. The system method of claim **11**, wherein the features reflect contextual information regarding the content items.

13. The system method of claim **12**, wherein the features relate to at least one of a user who flagged a content item and a user who uploaded a flagged content item.

14. The system method of claim **13**, wherein the features include at least one of reporting accuracy, abuse history, gender, age, profile completeness, profile verification, locale, friends counts, account age, number of reporters, language, and topics reflected by the content items.

15. The system method of claim **11**, wherein the content items include flagged content items.

16. A non-transitory computer-readable storage medium including instructions that, when executed by at least one processor of a computing system, cause the computing system to perform a method comprising:

determining scores for content items published in an online environment based on at least one machine learning model trained with features associated with the content items, the scores associated with probabilities that the content items include objectionable material;

selecting a subset of the content items based on scores of the subset of the content items and satisfaction of a threshold value; and

determining whether the subset of the content items includes objectionable material.

17. The non-transitory computer-readable storage medium of claim **16**, wherein the features reflect contextual information regarding the content items.

18. The non-transitory computer-readable storage medium of claim **17**, wherein the features relate to at least one of a user who flagged a content item and a user who uploaded a flagged content item.

19. The non-transitory computer-readable storage medium of claim **18**, wherein the features include at least one of reporting accuracy, abuse history, gender, age, profile completeness, profile verification, locale, friends counts, account age, number of reporters, language, and topics reflected by the content items.

20. The non-transitory computer-readable storage medium of claim **16**, wherein the content items include flagged content items.

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