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SYNTCREC: A SYNTACTIC RECOMMENDER BASED ON ENSEMBLE FEATURE SELECTION TECHNIQUE IN LARGE SCHOLARLY DATA

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ABSTRACT

Today's digital universe is suffering from the problem of data explosion which contain large volume of data generated at a daily growing basis in the world. RS (Recommendation System) is a best common solution which provides recommendations to users according to their interests. In recent years, recommender systems turn into tremendously famous system because of their capability to suggest user's favorites or ranking of a definite object by examining similar users within the network. This paper presents a novel recommender system called a syntactic Recommender which employs improved feature selection techniques that is combination of ACO-GA (Ant Colony Optimization-Genetic Algorithm) algorithms for feature selection to raise the accuracy of recommendations in recommender system. Feature selection is significant task for information retrieval processing. When matched to additional algorithms in the related works, this system showed to be tremendously successful in improving the recommendation accuracy.

KEYWORDS: Data Explosion, Recommendation System, Syntactic Recommender, Ant Colony Optimization- Genetic Algorithm, Information Retrieval

Scholarly documents are generated on a daily basis in the form of research documents, project proposals, technical reports and academic papers, in addition to several other types of documents, by researchers and students from all over the world. It is this huge reservoir of academia data that is popularly referred to as 'scholarly data'. The size of scholarly data unevenly doubles each decade. It became a big problem to find what the user is actually looking for. This result in need to filter, prioritize and efficiently deliver relevant information to users. Search engine partially solved that problem; however personalization of information was not given. Recommendation system is a solution for this problem. Recommendation System is information filtering system that presents list of items which are likely of user interest. Today, delivery of digital document happens within a single click by typing a few words of title or surname of authors. But whether the provided material is actually related to user interest. This results in need of informatics tools which provides targeted search prepared to facilitate researchers search required papers when they know almost what they are finding for.

The aim of this paper is to implement a system that offers two purposes, guiding users to the main literature in the field of their interest, while also offering ideas that may be valuable. This paper presents a system which provides following goals. This system (related to a seed paper) wants to decide (1) relevant papers related to the seed paper and (2) improve accuracy of recommendation, (3) handling huge volume of data. Recommender systems are generally classified into content based filtering, collaborative filtering and hybrid filtering. Collaborative filtering technique is the most mature and the most commonly implemented. Collaborative filtering recommends items by identifying other users with similar taste; it considers their choices to predict items to the active user. Collaborative recommender systems have been implemented in different application areas. GroupLens is a news-based architecture which employed collaborative methods in assisting users to locate articles from massive news database. Ringo is an online social information filtering system that uses collaborative filtering to build users profile based on their ratings on music albums. Amazon uses topic diversification algorithms to improve its recommendation. Collaborative filtering is commonly divided into two methods: memory-based CF and model-based CF. Memory-based CF comprises of user-based methods which suggest the ratings of active user based on the rankings of similar users found, while item-based CF approaches suggest the ratings of active user based on the computed data of items similar to those selected by the active user.

On the other side, content based techniques match content resources to user characteristics. Content based filtering methods usually base their recommendations on user's data, and they discard opinions of other users as with the case of collaborative techniques. Fab relies heavily on the ratings of different users in order to create a training set

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and it is an example of content-based recommender system. Content-based recommendation is divided into two types: syntactic based methods and semantic based methods. We argue only syntactic based methods in this paper since syntactic based methods have limitations in predicting high quality recommendations. Hybrid filtering contains two or more filtering methods in diverse ways in order to raise the accuracy and performance of recommendation systems.

To improve the performance of the feature selection methods, combining the outputs of multiple algorithms/classifiers is one of the promising strategies in information retrieval. Feature selection permits the decrease of feature space, that is essential in reducing the training time, an enhancing the recommendation accuracy. This is accomplished by eliminating noisy, redundant, and irrelevant features. Due to the significance of the feature selection problem and the latent of ACO, this system shows a new technique that uses the combination of ACO-GA algorithms to implement a feature subset search procedure. The main goal is to develop a text document classification System that is based on improved feature Selection techniques.

RELATED WORK

The huge amount of item information on the WWW shows big challenges to both users and businesses in the e- commerce environs. Customers commonly experience trouble in finding for items on the WWW, while online businesses are often suffer from the large data they have composed and discover it hard to stimulate products suitable to precise customers. To handle this information overload problem, researchers have proposed recommender systems that automatically evaluate users' usage information to sift content of Web page, classify newsgroup messages, and recommend good information resources. Ujjin and Bentley (2003) have presented PSO (Particle Swarm Optimization) recommender system in which PSO algorithm has been utilized to study personal favorites of users and deliver tailored recommendations. They proved that PSO system outperformed a non-adaptive method based on the Pearson algorithm and got higher recommendation accuracy than the genetic algorithm system and Pearson algorithm in most cases. Zan Huang et al. (2004) describe some challenges that are faced by customers and system. Customers often experience difficulty in getting, searching and recommended results at the same time for required product within large amount of data. To overcome two major problems i.e. presenting diverse information and flexibility of the system to incorporate different recommendations Zan proposed a graphical model that contains nodes of customer & products and respective links of transactions & limitations. This tested using three approaches (association mining, direct retrieval, high- degree association retrieval) of creating recommendations with three methods (content-based, hybrid, collaborative).

Recommender systems are generally independent of different approaches. Enhancing the recommendation quality is fundamental challenge for recommendation systems. Hence, recommenders are often combined with other technologies. Recommender systems is also acts as classification system. David Martens (2007), et al. presented a novel ant based classification method called AntMiner+ which uses ACO (Ant Colony Optimization) algorithm. When matched with advanced classification methods, AntMiner+ positions at the entire top by determining accuracy and comprehensibility. But AntMiner+ needs more processing time than the other methods.

P. Bedi et al. (2009) proposed ARS (Ant recommender System) built on ant's collaborative activities for producing TOP-N predictions. Ant recommender System implements in two stages. Stage I is the preprocessing stage that is offline. Stage II, is online recommendation stage in which recommendation process takes place. In this phase, deposition or evaporation of pheromone by ant algorithm is joined with similarity measure for selecting the finest clusters for creating the recommendations. This results in enhancing the recommendation quality for the current user. When the number of recommendations rose, precision fell smoothly. Janusz Sobecki and Jakub M. Tomczak (2010) present student courses recommendation using ACO (Ant Colony Optimization).The basic of courses recommendation is to provide for every student, prediction of grade for all the courses so that he or she has chance to admit. The recommendation is achieved by integrated hybrid approach (HA) information filtering based on ACO. Author proves that ACO technique acts more stable than several other recommenders. In this, student is defined only by little features. So that, for higher accuracy, more detailed student description required.

Mojtaba Salehi et al. (2013) proposed a Semantic Recommender built on ACO Meta-Heuristic in E-

Commerce. This scheme includes stochastic, heuristic, reinforcement learning in theory of Ant Colony and semantic relation within ontology characteristics for improving the electronic commerce procedures. The offered system is capable to predict complement, similar and bundled items. Ontology describes the fundamental terms and relationships containing the vocabulary of a subject matter as well as the rules for joining terms and relationships to state additions to the dictionary.

Manisha Sajwan et al.(2014) defines a SI(swarm intelligence) optimization aimed at web mining to discover the optimal result. For web page recommendation, author show a graph based method, controls the logs of operator browsing to find early adaptors, there operator identify interesting content before author and observing their doings, we can catch web pages to predict. This research has been made known that recommendation is happened by means of Swarm Optimization methods. This study announces the theoretic basics of the biological motivation and SIO(Swarm Intelligence Optimization) methods with an emphasis on Web-Page Recommendation. Lina Yao et al.(2015) proposed web service recommendation using unified collaborative and content based approaches. WSRec (Web service recommendation) is the method of automatically finding the usage of services and proactively predicting services to active users. Author proposes a 3-way feature model that concurrently determines the likenesses of users and web services semantic content. Users first choices are modeled as latent variables set in the feature model. This approach outperforms the conventional collaborative and content-based methods in terms of recommendation performance.

Abdelghani Bellaachia et. al., (2016) proposed ALT-BAR (Averaged Localized Trust-Based Ant Recommender), a recommendation algorithm that shadows the policy applied by ACO (Ant Colony Optimization) algorithms to raise the prediction accuracy in recommendation systems, mainly aimed at cold start operators. ALT-BAR emphasizes the importance of trust among users, to overcome the absence of ratings, by adjusting the way the starting pheromone levels of edges are considered to replicate each edge's related trust level. When matched to other algorithms in the collected works, ALT-BAR showed to be tremendously successful in improving the accuracy of prediction and coverage aimed at cold start operators while still keeping honestly good outcomes aimed at weighty raters. Suruchi Chawla (2016) proposed web page recommendation using hybridization of Trust, Ant Colony Optimization (ACO) and Genetic Algorithm (GA) for effective Information retrieval. The proposed approach uses the trusted colonies of web pages in a given cluster domain for rank optimization using GA in order to recommend relevant documents up in ranking for effective information retrieval. The operator's clicks to the web pages that recommended is caught online using pheromone update in ACO for optimizing the path of trusted clicked URLs and uses GA for their optimal ranking. The process of recommendation of clicked URLs set with optimal ranked continues till the search is personalized to the data need of the operator. The improvement in the average precision of search results confirms the effectiveness of proposed method.

In common, syntactic-based methods have restrictions to recommend recommendations with high quality. By using combination of ACO and GA with Syntactic-based approach, we can improve accuracy of recommender system. This becomes the first novel method to present high quality recommendation.

ANT COLONY OPTIMIZATION

The real ants seeking activities gave birth to ACO algorithm which is a metaheuristic. It was presented by Dorigo with colleagues to get solution of optimization problems in 1990s. When food stuff is identified, ants place certain pheromone to spot the route. The amount of the placed pheromone based on the distance, amount and quality of the food stuff. While a lonely ant travels basically at random, an ant meet the earlier placed trail can identify it and consider with high possibility to follow it, thus highlighting the trail with its own pheromone. This enables indirect communication among the ants through pheromone trails and to discover the shortest route between the foodstuff and their nest. Artificial ants place pheromone on edges of the graph and they select their route with subject to probabilities that based on pheromone trails that have been earlier placed by other ants. These pheromone paths increasingly drop by evaporation. In our proposed system we used the combination of ACO and GA for feature selection.

Ant Colony Optimization for Feature Selection

Feature selection is to discover a minimal subgroup of relevant features, such that to maximize the classification

accuracy. Optimization capability of ACO can be used to select features. Every original feature is acted as a graph node to build graph G, and then detect feature subset depends on this graph. Nodes are fully linked to permit any feature to be nominated next. ACO algorithms are stochastic algorithms that build probabilistic decision using history of earlier successful transfers and visibility of the edge.

The space of solution is primarily vacant and is extended by addition of a solution element at each probabilistic choice. This successfully balances the exploitation–exploration trade-off. At the final stage of each iteration, ants that have detected good solutions are prepared to spot their route by adding pheromones on the edges selected by them. After all ants have finished their solutions, pheromone evaporation on all edges activated.

Usually, optimization problems are denoted by a network containing nodes and edges. Typically weights are presented with those nodes and/or edges. As per actual ants, artificial ants within an ACO are transmitted from one node in the network with numerous iterations to find the solution space for good solutions. ACO algorithm is used for feature selection. Feature selection is used for dimensionality reduction of original feature set to get the more relevant feature space for classification. The overall performance of ACO is better than that of both GA and SFS (sequential Forward Selection), where the average classification accuracy of ACO, GA and SFS over all the cases are:84.22%, 83.49% and 83.19% respectively.

Genetic Algorithm

A genetic algorithm is a metaheuristic motivated by the method of natural selection that fits to the bigger class of evolutionary algorithms. It is usually deployed to generate high quality results to optimization and search problems by depending on bio-inspired operatives such as crossover, mutation and selection.

Genetic Algorithm for Feature Selection

Genetic algorithm is one of the most innovative algorithms for feature selection. Genetic factor of organism founded in nature have a tendency to develop over successive generations to better familiarize to the environment. The GA is heuristic optimization process motivated by those processes of natural evolution. In this case, every single in the population denotes a feature vector. The quantity of genes is the total amount of features in the database. Here, Genes are binary values, and characterize the inclusion or not of specific features in the model. Consider all the feature vectors as initial population. The population size must be selected for every application. Genetic algorithms commonly implement better than classical feature selection methods. Genetic algorithms can adjust databases with various features. They don't require exact knowledge about the problem under study. Genetic Algorithms might be very costly in computational terms, since costing of every individual needs constructing a predictive model. These algorithms can yield a long time to meet, since they have a stochastic nature. Genetic algorithms can choose the best subset of variables, but they commonly need many computation.

Proposed Feature Selection Algorithm

It is a combination of ACO and GA algorithms to remove their limitations. In other words, there is no need to predefine the number of features to be selected (limitation of ACO) and this task is assigned to the algorithm to select feature subsets with arbitrary numbers. Like ACO-based FS approach, the problem is defined as a fully connected graph where nodes represent features, with the edges between them denoting the choice of the next features. There are two sub-nodes assigned to each feature in the graph, one for selecting and the other for deselecting the corresponding feature Based on the pheromone values ants decide their next edge. In each iteration, all ants should visit all features, but can decide whether to select a feature or not. If an ant chooses sub- node 1(or0) of feature Fi, it means the feature is selected (or deselected) by that ant. Note that, ants are only allowed to select one of the sub-nodes of each feature; sub-nodes1or0.For the next step, this ant can see all the unvisited features. Again, there are two roads ending to each feature, based on the pheromone values and heuristic information.

Proposed Algorithm

This section describes the proposed approach as shown in fig. 2. This is a syntactic recommender algorithm. This recommender provides recommendations with high accuracy by using the improved feature selection techniques to label the document with its correct domain. To improve the performance of the feature selection techniques, ensemble of multiple feature selection algorithms is one of the promising strategy in information retrieval. Because of the capability of ACO, this system proposes a new method that employs the ensemble of ACO and GA algorithms to

perform a feature selection procedure. The aim of this system is to develop a text document classification System that is based on improved feature Selection techniques. It emphases on domain assignment to the documents used for training the model. This system use Hadoop which is a big data processing distributed framework. This provides benefits of handling interactive and iterative algorithms with minimal processing time and efficiency as related to classical map-reduce models. This system implements in two phases. Preprocessing phase is the first phase, in which the background data in the form of pdf files are collected and classified using TF/IDF and ant based cosine similarity algorithm. When the categories are achieved, the classified data with their domain are kept in the dataset for future recommendation. Recommendation phase is the second phase, in which test dataset is classified using training dataset and most relevant papers recommended as per users query. The steps of Syntactic recommender can be described by the flowchart shown in Fig.1, which are described in more details as follows.

- Step 1: Initialize and load the training and testing database.
- Step 2: Perform preprocessing steps (tokenization, stop word removal, stemming, term weighting) to test documents.
- Step 3: Apply feature extraction (TF-IDF) to test documents.
- Step 4: Ensemble of ACO (Ant Colony Optimization) and GA (Genetic Algorithm) used to select features for classification.
- Step 5: Apply Cosine Similarity technique to improve the document classification accuracy.
- Step 6: ACO classification system works by comparing features of test document with the features in train database.
- Step 7: Set of relevant documents displayed.

EXPERIMENTAL STUDIES

A series of experiments are conducted to show the effectiveness of the proposed ensemble feature selection algorithm. All experiments were performed on a laptop with 2.40GHz Core i3 and 4 GB of RAM using Netbeans and Hadoop in JAVA environment. To validate the results obtained by the proposed algorithm, it is compared with binary genetic algorithm (BGA), ant colony optimization (ACO) and the results obtained are reported.

Data Tables and Discussion

Training Dataset

Main task in training is creation of train data set using which classification of unknown data in predefined categories is done. Here a learning system is created using machine learning approach. It is a supervised learning where unlabeled data (test data) is classified using labeled data (training dataset). Training data is always a labeled dataset based on its features.

Project had considered 100 scientific papers form different publication of different domains for creating training dataset. These papers are input for creating training dataset. This input is first preprocessed and most informative features are extracted using TF/IDF and cosine similarity which are part of Ant Colony Optimization Algorithm. Ten different domains from market are identified and then extracted feature and have to put to corresponding domain where each domain is considered as one class that which is used for labeling test dataset in testing part and features are considered as nodes. Once training part is completed, all features of respective domains are getting updated in corresponding tables in database.

Testing Dataset

When .pdf (scientific papers) is inputted in testing, data preprocessing is done as in training for feature extraction and most informative features are selected using TF/IDF and cosine similarity. These features are considered as nodes of graph. Then these features are matched against training dataset which already created based on their similarity. And similarity score is assigned corresponding to each domain using ACO algorithm. For classification, system will provide the related paper with available citations in base scrip with proposed system.

Evaluation Function

The features selected by the proposed algorithms are evaluated with the well-known metrics precision, recall, accuracy and feature-reduction. Precision is referred as the ratio of correctly allocated category C samples to the total number of samples classified as category C as in Eq. (1). Recall is the ratio of correctly allocated category C samples

to the total number of samples actually in category C as in Eq. (2).

Let , , and indicate a number of samples as follows:

– the number of test samples correctly classified under ith category ( ).

– the number of test samples in correctly classified under .

– the number of test samples correctly classified under other categories.

– the number of test sample sin correctly classified under other categories.

In this paper, classification accuracy (CA) is used to define the quality recommendation of a solution, which is the percentage of samples correctly classified and evaluated in (3). Another parameter which is used for comparison is the average feature reduction Fr, to investigate the rate of feature reduction.

Where n is the total number of features and p is the number of selected features by the FS algorithm. Fr is the average feature reduction. The more it is close to1, the more features are reduced, and the classifier complexity is less. The following section presents the implementation outcomes.

Experimental Results and Analysis

The performance of the classifier is calculated in accordance with the accuracy outcomes. Suggested categories given by classifier compares with the actual categories of the test documents. For that, first of all the number of True Positives, False Negatives and False Positives are evaluated, then accuracy, precision and recall are calculated with these values.

Experimental results compared with three systems as shown in Table 1. Shima Kashef et al. compared the performance of various optimization algorithms on the task of feature selection on various UCI dataset in Table 3. Janusz Sobecki et al. showed that ACO method behaves more stable than any other recommender. Fig. 6 shows the system classification graph. The graphs display how system classify the overall inputs into categories. The proposed system is implemented with ACO-GA combination, which gives all results with satisfactory level. For performance evaluation, 70% documents given for training and 30% documents given for testing. Here system compares the proposed results with two different existing systems as shown in Fig. 7.

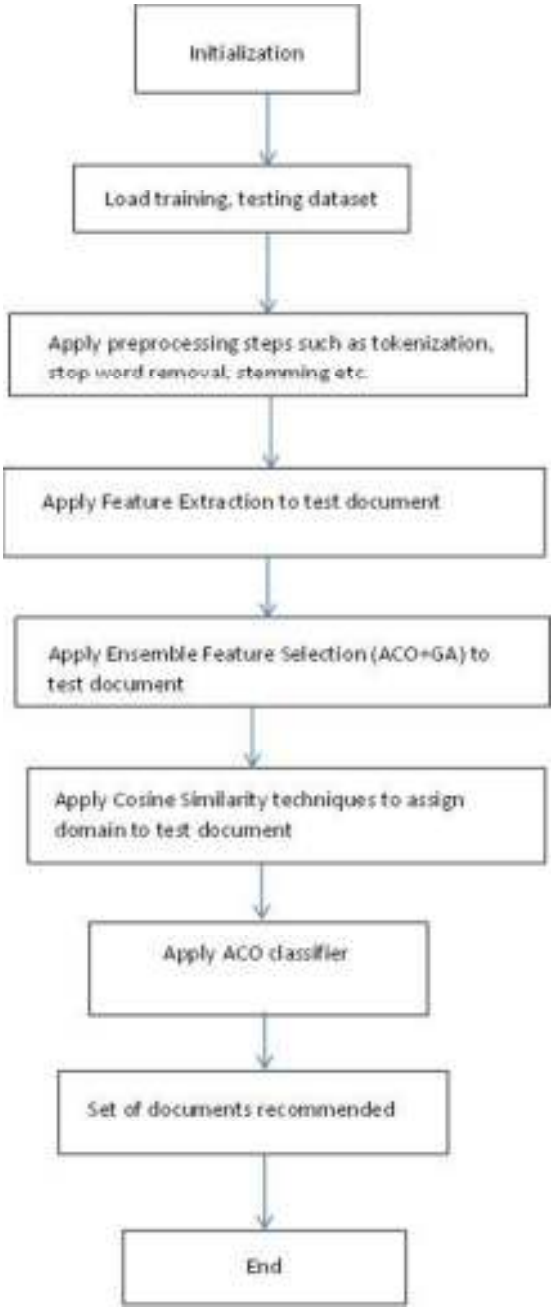

Figure 1: Flowchart of Syntactic Recommender

Figure 2: Architecture of Syntactic Recommender

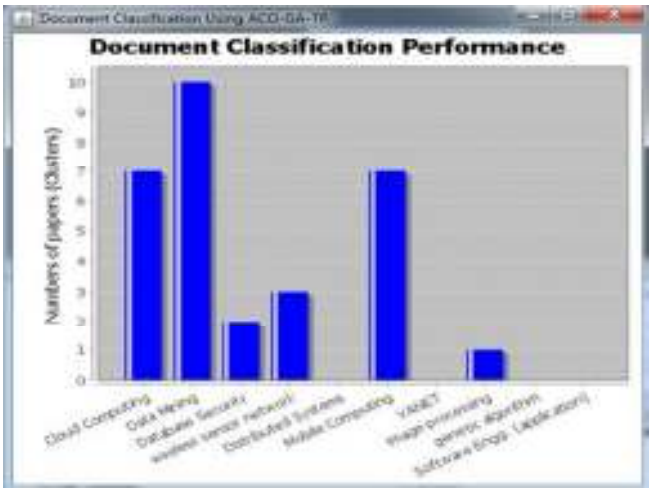

Figure 3: Domain Classification Accuracy

Table 1: Comparision Table

Author	Algorithm	Dataset	Accuracy in %	False-Rate in %
Shima Kashef et al.,2015	ACO	Letter	85.6	14.4
Shima Kashef et al.,2015	BGA	Letter	83.7	16.30
Janusz Sobecki et al., 2010	ACO	Real data from university	88	12
Proposed System	Syntactic Recommender	IEEE base pdf dataset	92.50	7.50

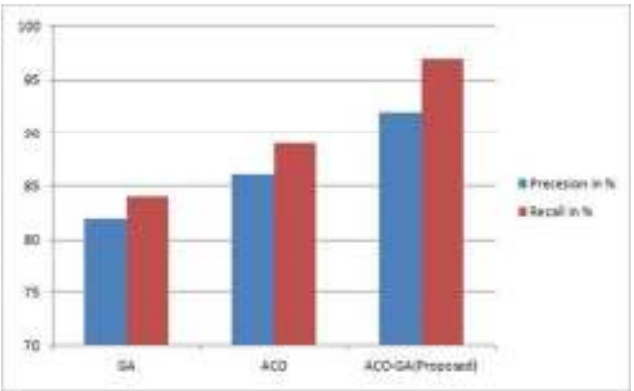

Figure 4: System performance results with existing system

CONCLUSION AND FUTURE WORK

Feature selection plays an important role in the performance of Classification. It helps to improve the performance of classification and recognition. This paper presents a new feature selection technique by combining two algorithms, ACO and GA. The proposed algorithm has a strong search capability in the problem space and can efficiently discover the minimal feature subset. In order to calculate the performance of these methods, experiments were accomplished using pdf datasets. The experimental results approve our algorithm and offer obvious indications, permitting us to conclude that our method achieves a better

feature set in terms of classification accuracy and number of selected documents for recommendation. The proposed system, we implement with ACO-GA combination, we got all results with satisfactory level. System compare the proposed results with two different existing systems. We can get high quality recommendation using this novel method using Ant Colony Optimization Techniques. To increase accuracy and efficiency of hybrid recommendation with ACO techniques in this domain is the area of future research.

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