

A Study on Swarm Intelligence Techniques in Recommender System

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ABSTRACT:

Swarm intelligence deals with natural and artificial system provides an efficient way for finding optimal solution. During the past few decades researches are trying to use these techniques to solve many problems in various fields. Recommender system is the one of the most important application of E-Commerce and it plays vital role in understanding the users' behavior or interest by which it increases the profit of sales or usage of services of a web site. This paper describes a study on swarm intelligence techniques to find the optimal solution and based on that recommendation process is done.

Keywords: Recommender System, Swarm Intelligence Techniques, Natural Inspired techniques, E-Commerce.

1. INTRODUCTION:

Nature inspired computing techniques such as Swarm Intelligence (SI) has the ability to solve many combinatorial problems and provide optimum solution. In a decentralized system the collective behavior of individual interact within local or global environment. In this environment user has difficult to find the optimal solution in the tremendous information so, this can be overcome by recommendation process. In the neighborhood process it can find nearest neighbor with users of similar likes and dislikes and therefore generate more better and personalized recommendations. Based on content provided by the user their similarity is identified.

This paper focuses on two parts that is swarm intelligence algorithm and other on recommended system.

First part it narrates about swarm intelligence techniques which describes a study on collective behavior of ant, bees, etc., and second part user profile are selected based on neighborhood usage of SI

The paper is organized as follows: section 2 outlines a deep study on most popular SI algorithms and section 3 provides application about SI. Finally section 4 describes web personalization using SI.

2. SI ALGORITHMS:

Several collective behaviors such as bees, ant, firefly, cuckoo, etc., inspired algorithm have been proposed. These algorithm provide problem solving ability and study on this makes human understandable in nature. The main principles of collective behavior of swarm are homogeneity, locality,

collision avoidance, velocity matching and flock clustering. Some of the popular SI algorithms are:

1. Ant colony optimization
2. Bat algorithm
3. Cuckoo search
4. Firefly algorithm
5. Particle swarm optimization

2.1 Ant colony optimization:

Ant colony optimization (ACO) is a behavior of ants that finds its path between food source and colony. Ant while returning colony lay down pheromone, which directs the search of future ants on the same path. This helps to find the optimal solutions. They use the environment as a medium of communication. Some of popular variations of ant colony are edges, Max – Min ant system, convergence and pheromone update. ACO has been useful to solve many combinatorial problems and optimum solutions it is also used in web usage mining to each user [1].

2.2 Bat algorithm:

Bat algorithm (BA) is a Meta heuristic optimization inspired by the echolocation of micro bats. Bats are one kind of mammals that have the capacity of echolocation. These bat produce loud sound based on the echo reached it identifies the obstacles and severs even in dark. Many researchers found the behavior of bat has the solution to many complex problems.

2.3 Cuckoo search:

Cuckoo search (CS) is a swarm intelligence inspired by the some cuckoo species they lay their eggs in the nest of another birds. The breeding behavior is applied to many optimization problems. Each egg represents the solution. Recent studies suggest that comparison between CS searches with PSO says CS is robust results. The behavior of cuckoo is described in [3].

2.4 Firefly algorithm

Firefly algorithm (FA) inspired by the flashing behavior of fireflies. The firefly behavior is applied in [2]. Firefly algorithm consists of three rules:

- 1) No firefly will be attracted to another since they are unisex
- 2) Attractiveness is proportional to brightness that is less brighter one is attached to brighter one.
- 3) If no firefly is brighter than the giver firefly then they are moved randomly.

In fact the variants of firefly algorithm are discrete firefly algorithm, multi objective FA and so on. It is applied on image processing, clustering, continuous optimization, etc.

2.5 Particle swarm optimization

Particle swarm optimization (PSO) is a swarm intelligence global optimization technique. It was founded in 1995 by James Kennedy and Russell Eberhart to model the convergence behavior of a flock of birds [5]. It is mainly inspired by the social behavior of bird flock and fish school. In this if one particle identifies path for food source or protection then rest of swarm follows it automatically even if it is in opposite direction. The birds also have the capacity to smell the food so it finds the optimum solution to find the food. Using the pre-defined fitness function the performance of each particle is measured.

3. SI APPLICATIONS

The purpose of this section is to provide some real-life time problems and applications used in swarm intelligence and provide the readers with survey of existing techniques. Many researches with different background use the SI algorithm to solve their complex problem. As a result, there was success in their research with different domains reporting successful applications. During, the recent years the area of research in SI increases tremendously and succeeded in their research process.

3.1 Ant-based routing

Ant colony optimization (ACO) has been used in many domains. Ant Colony based routing algorithm that helps routing which flood in the network. The idea behind this is which a group of ant work better than the single ant work. Here each ant is considered as a small packet in the network. The forward reinforcement and backward reinforcement is analyzed. The same routing is applied to Airlines where pilot act as an ant to reach the optimum destination airport.

Likewise, it also used in Mobile Ad-hoc network. Similarly, networks the forward and backward ant is used for packed in the network. The forward is the rewards the route and the backward it transmit and receive data in equal rates.

3.2 Crowd simulation

Crowd Simulation offers many challenging approaches. These approaches are simple to implement and fast. The first movie to implement the SI technology developed from the behavior of birds or fish was “Breaking the Ice”. The movements of Bats are also shown by Tim Burton’s.

4. WEB PERSONALIZATION USING SWARM INTELLIGENCE (SI)

As the usage of internet are increasing day-to-day life, the users’ interest and opinions also differ, large amount of time is spend to group similar user to solve this problem recommendation plays a vital role. It helps to group similar users together. Web personalization reviews contents or structure of user web data [4].

Recommendation gives suggestion about user based on their information previously provided or currently visited web page. The optimal solution on diversity is found by recommendation. Based on customer likes and dislikes they are usage profile is grouped. The following steps are required

to generate the recommendation for the active user based on the extracted optimal usage model from the given web log data. They are:

4.1 Usage Profile Generator

First step is to collect usage profile of the each user from the given web site. The profile (A, J) represents the usage profile user ‘A’ for j item. Before the recommendation is made the data is first processed into separate profiles. It has two parts profile part and fixed part [6]. After the profile is constructed similar profile are grouped together from the given dataset. For the given user, the set of similar profiles are identified using the swarm intelligence based method as described in the next subsection.

4.2 Identifying the optimal nearest usage profile using SI:

One among approaches of recommendation is collaborative filtering to find similar users from large amount of information. The best closest similarity is found using neighborhood selection. The optimal nearest usage profile is identified using the SI optimization techniques. Using the fitness function, the optimal nearest usage profiles for the given active user are selected. This fitness function is crucial and necessary step to identify the optimal nearest usage profile and it can be used in any of one of the SI techniques like ACO, Bat, Cuckoo search, Firefly and PSO. The unique behaviors of user are analyzed [7].

4.2 Profile Matching

The profile matching is used to calculate the distance between profiles with the help of distance function. This can be easily computed using Euclidean distance. The multiple user similarity also found using distance measure. Euclidean (A, J) can be defined as

$$\text{Euclidean}(A, J) = \sqrt{(A_1 - J_1)^2 + (A_2 - J_2)^2 + \dots + (A_n - J_n)^2}$$

Using this function the similarity between profiles is calculated and the nearest optimum is chosen. Profile matching is to find the nearest profile. The system then simply selects the users whose Euclidean distance is above a certain threshold δ value (considered most similar to the active user) as the neighborhood of A. The following fitness function is the optimal set of usage profile for the active user A as:

$$\text{fitness}(A, J) = \begin{cases} \text{sel}_{\text{profile}} = \text{union}(\text{sel}_{\text{profile}}, J), & \text{if Euclidean}(A, J) < \text{threshold} \\ 0 & \text{otherwise} \end{cases}$$

Where: A is the active user
 $\text{sel}_{\text{profile}}$ is the selected profile for the user A
 J is the profile in the dataset

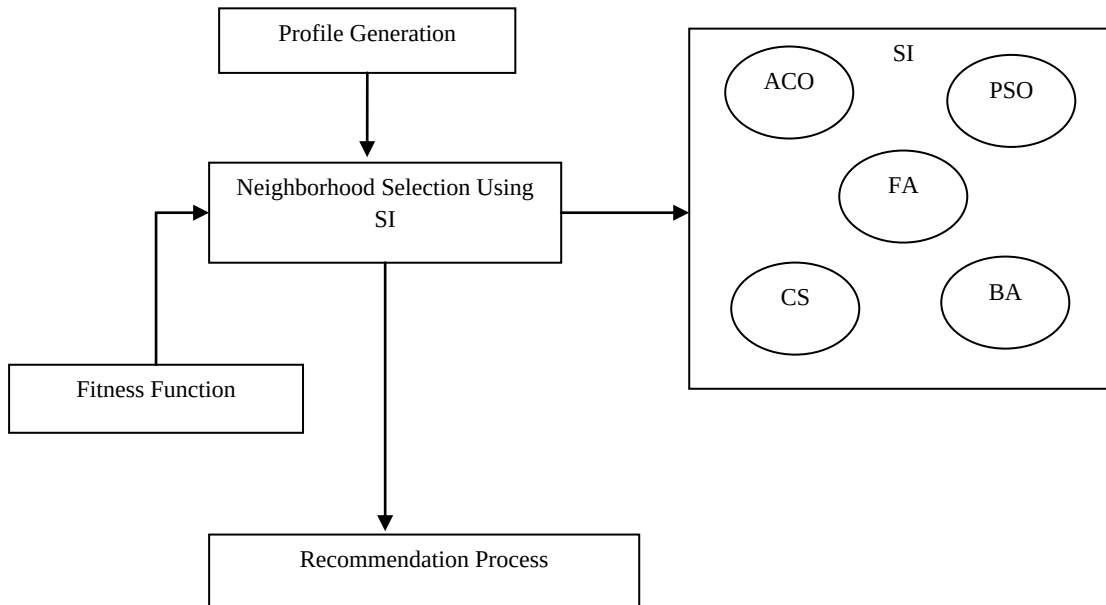


Fig. 1: Recommendation using SI

The usage profile (A, J) is calculated by Euclidean distance is measured to identify the similarity.

The neighborhood selections are processed to find the optimal solution the users that are most nearest to current user. Suppose A is the current active user the user that are near to A with similar likes are found they are the optimum solution for user A. The profiles are selected from the dataset. Based on the threshold value the profiles are grouped. The profiles that are most similar the best among them are chosen. This could be quite inconsistent for irrelevant user.

Web personalization implicitly or explicitly collect the data from the user. The figure1 represents the framework the way recommendation is obtained. After the profile is generated obviously, it is ready for recommendation. The next step after profile generation is the neighborhood selection it can be processed by any one of five popular SI techniques. Next step to calculate the fitness function based on the threshold value. The final stage is the recommendation process is generated.

This work is referred from [6] in that the best profiles are collected using genetic algorithm.

It is surprising that the SI performs the similar work to choose the best profiles. On the other hand the threshold means an appropriate value is given to calculate the fitness function. The web recommendation is discussed in [8].

5. CONCLUSION:

This work has been shown that recommendation process is carried on with SI techniques. The fitness function is obtained to select the profile of similar user. Five most popular SI techniques such as ACO, PSO, BA, FA and CS are learned with the applications to personalize web-based techniques. The two main approaches of personalization is profile matching and profile selection are discussed to understand the user better.

6. REFERENCES

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