

Artificial Intelligence based Recommendation System

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Abstract—Artificial Intelligence (AI) is a modern engineering method to make machines think or use their intelligence like humans by mimicking traits and by learning to take appropriate decisions and to perform assigned tasks properly. Some of the companies which have done remarkable work in the field of Artificial Intelligence (AI) are Facebook, Google, Microsoft, IBM, etc. which are investing millions and billions in this very field of AI development and research. Currently there is a huge market and need for building Intelligent Systems for Recommendation. To counter this, one of the easiest and most preferable System is Recommendation System (RS). Recommendation Systems had proved to play an important role in the field of E-Commerce websites, Online Shopping, Dating Apps, Social-Networking, Digital Marketing, Online Advertisements, etc. by providing personalized recommends and feedback to users according to their preferences and choices. The topic of this report is AI based Recommendation System. As the topic of this paper suggests we are going to discuss about various ways and approaches of Artificial Intelligence (AI) to build a Recommendation System (RS) application. There are many approaches to build a recommendation system according to one's need like Collaborative Filtering, Content based Recommendation Systems, Hybrid Systems, Artificial Neural Networks, Swarm Intelligence, Evolutionary Computing, Fuzzy Sets, etc. which will be briefly discussed in this report, but we will primarily discuss and work on Collaborative Filtering approach and about the problems like Cold start, Sparsity, Scalability and some others.

Keywords— AI; Recommendation Systems; Collaborative Filtering; AI based RS component;

I. INTRODUCTION

The quick broadening of software industry has guided to evolution of customized R.S.s. A R.S. inspects individual predilection of individual customer & recognizes a lay of stuffs which can be of attention to a definite customer. R.S.s were previously utilized in various websites to endorse numerous stuffs namely news articles, music, movies, books, etc. By implementing R.S.s, individual may suppose to surge trades by imparting correct info to the correct customer. There've been numerous procedures recommender techniques. Content-based recommender technique study the documented data about chosen stuffs & acclaim new stuffs through discovering stuffs with analogous info [1]. Subsequently C.B. technique remains suitable where rich illustrative info is present. There stand structures which utilizes C.B. procedure & C.F. procedure collectively [2,3]. C.F.B.R.S. analyze likenesses among consumers according to predilection statistics, like buying history, & expects a consumer's

fondness on stuffs according to like consumer's predilection on same stuffs [4]. Numerous variations had been anticipated for advancement of presentation [5,7]. Demographic R.S.s stay alike to C.F.B.R.S.s, but they analyze likenesses among consumers according to their demographic statistics, like occupation, sex, age [8,9]. The detachments among users are calculated by means of that info, and a user's predilection on certain item is predicted by using the neighbor's preferences. Recommender Systems are not just about suggesting products to users, but sometimes it can be about suggesting users for products. Many times, recommender systems are not about what we think of them as a product. For example, when google maps suggests a toll-free route to avoid toll that's also a recommender system. So, with this we can conclude that Recommender System is about personalization. There are mainly two methods to construct a R.S. which are C.B.R.S & C.F.B.R.S.s

II. LITERATURE REVIEW

As per reference no. [10], the paper anticipated a recommender technique using case-based reasoning. The system helped students to choose the favorable optional subject by taking input like subjects in which a student is intrigued in, scholastic activities of students, and some more information was provided to the system about each optional subject. So, by examining this data the system provided the students with the exact and/or most precise subject keeping in mind the performance of that student in compulsory subjects. The paper also debates about designing a problem vector and solution vector to store user preferences. This system used 4R system.

As per reference number [11], a survey was performed in which they briefly discussed about various recommender systems like Content based Recommender Technique, Collaborative Filtering based RS, Hybrid Recommender System and spoke about the method/technique to figure a Hybrid System by merging both Collaborative Filtering and Content based RS. They also discussed about various problems which arrive when creating a new recommender technique like Cold Start, Sparsity, Limited Coverage, Diversity and Over-Specialization. The paper also included and discussed about various AI techniques like Fuzzy Sets, ANN, AIS, Swarm Intelligence and Evolutionary Computing. As per reference number [12], a system was introduced to learn preferences of new users in Recommendation Systems. They proposed a Collaborative Filtering method to counter problems like Cold-Start which generally comes in the

instance of a new user profile. For a new user, his/her proclivities are not available or not known to the system. They used various strategies to learn about new user profiles by taking in account various aspects like Popularity of the item/product, Entropy and Entropy0: as there are many available items which are never rated by any user and if we assume a scale out of 10 they will come at 0. So, they characterized this type of product in Entropy0.

As per reference number [13], a system was developed namely ARGUENET for prioritization of web search results. The paper discussed about the barriers like not prioritizing the use of qualitative aspect and using quantitative approach to recommend users. When we search/browse on the internet, the results are shown according to the input we provide as keywords which are there in the searched topic but not considering the users' preferences. To build this software namely ARGUENET, the authors used Argument-based Recommender Technique.

As per reference number [14], a work was developed mainly about works related to Recommender Systems on E-Commerce Websites using implicit feedbacks as there is very few Explicit information present on E-Commerce websites. The researchers used pseudo rating data from the implicit feedback information. The paper talks about the kind of data used to build a pseudo rating array, like time of purchase of the items, the launch time of items, feedbacks provided by the users to the system. The authors established a recommendation system utilizing time-based technique.

As per reference number [15], a technique was proposed to build a Collaborative Filtering based Recommender System while using Artificial Neural Network. The paper validated the result obtained by Collaborative Filtering by cross checking it by Artificial Neural Network. The paper briefly discussed about ANN, Support Vector Machines and the types of approaches for building a RS. The paper also included work related to tackle problem like Complete and Incomplete Cold-Start. This work included the use of CF approach, LSVM and the ANN.

As per reference number [16], an analysis was discussed of modern experimentations on Evolutionary Computing based Recommender System. The research paper used Evolutionary Computing technique to analyze recommender system. The research paper included five aspects to Recommender system: The R.S. anticipated, sets of info. and development means implemented in demonstrative part. Criterion used in investigational contrast of projected methods, dependability of described experiments. Paper also analyzed the various approaches to build RSs.

As per reference number [17], a swarm intelligence and evolutionary computing method was developed to build recommender systems using: Ant colony optimization, Particle swarm optimization, clustering based approaches, latent factor models, scalability and time complexity, evolution matrices and methods. They also addressed Recommender system's challenges and issues like sparsity and scalability. These complications were addressed principally using clustering-based method. Cold-Start problems, context awareness and

integration of numerous assorted measures in suggestions were also defined in detail.

As per reference number [18], a system was projected which offers an inclusive review of the tourism recommender systems. Several aspects were analyzed from these recommender systems like their interface, their functionality, their recommender mechanism and the AI methods and techniques employed. They also provided the merits of Semantic way of representing information and moving away from pure textual information. A thorough review of the field, in view of the unlike interface was provided in the paper.

As per reference number [19], a system was performed for decision making process using Multiple-Criteria Decision Analysis. The researchers used hybrid recommender system with collaborative filtering technique for identifying most preferred unknown items for every user. They also used Utilities Additives (UTA) algorithm demonstrated the accuracy and efficiency of the proposed methodological framework and compared it to several CF techniques. They used three phase framework which included Data Acquisition, Multicriteria User Modelling, Clustering and at last Recommending.

As per reference number [20], a review of various papers, journals and other resources was proposed, related to the development related to Recommendation Techniques in recent years. The paper included various classification methods. This included classification on the basis of application fields, data mining technique, classification processes and year of publication.

As per reference number [21], a system was developed to build a recommender system for tourism and travel. The paper talks about various problems while building a tourism RS. The work included various considerable filtering techniques like basis of info. strategy and assortment, viewpoint, K.B.F. & R., C.B.F. and media cataloguing methods, C.F.B.R.S.s and Hybrid systems.

As per reference number [22], a system was developed on health management specially to support Diabetes Management. The paper provided a detailed overview of various health recommender systems like CoachMe, Rapid calc diabetes manager, mySugar, Diabetes:M. The paper suggested R.S. system based on Collaborative Filtering and implementation areas like helping people with dementia to accomplish their everyday task, recommends for elderly people. It also talked about usage of domain knowledge in Rule based Personalized Health RS and its advantages.

As per reference no. [23], a recommender system was offered for recommending movies. The Recommender system proposed in the paper mainly uses of formation of movie groups according to genre info. The system was based on C.F. technique using User-based and Item-based CF tactic. It was used to provide item recommendations to a target user by analyzing their interests. The paper incorporated the positive as well as negative characteristics of Collaborative Filtering.

III. METHODOLOGY USED

With the growing environment and improvements over discipline of IT sector, info/data burden has become a big problem, making the whole internet environment messy and to get rid of this problem. R.S.s deliver great help to customers. Recommender Systems deliver the users with the utmost precise and pertinent feedback which are of customers' interests and assist/help users in making a better decision. R.S.s are computer programming tools which expect & advise stuffs by calculating similarity from interactions between item and user. To build such software programs by means of C.B.F., C.F. and Hybrid R.S.s numerous algorithms are required.

To build a Recommender System, numerous kinds of methods and approaches are present. Some of them are procured and conferred briefly in this segment.

A. Content-Based (CB) R.S.: -

The items which are analogous to the earlier chosen items by definite user are recommended in content-based recommender technique. The basic principle involved in content-based recommender system are:

The items' description which are preferred by the user are analyzed to determine the principle common attributes which are used to differentiate between the items and the preferences are then saved to user profiles.

In order to recommend, each items' attributes are compared with the user profile so that the items with higher degree/number of similarities are recommended. [10]

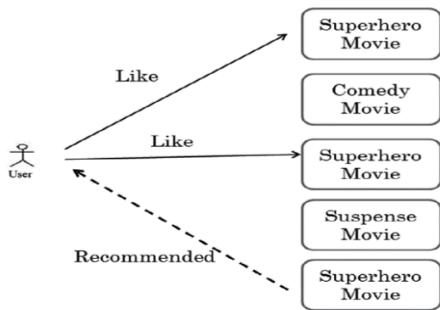


Fig. 1. A content-based Recommender System

B. Collaborative Filtering (CF)-Based R.S.: -

The C.F. based R.S. is divided into two parts-

The User-Based Collaborative Filtering- In user-based approach, those items are recommended which are popular, liked and are in great demand in similar kind of users.

The Item-Based Collaborative Filtering- In item-based C.F. method, those kinds of items are suggested which are equivalent to the items which are loved and are mostly browsed by the users. [15]

C. Hybrid Recommender Technique: -

This type of Recommender technique is developed when both Content based RS and Collaborative Filtering based RS are

combined to make a better recommender technique. In Hybrid recommender technique problems like cold start are almost negligible as it works on principle of both approaches which permits the structure to recommend customers without prior knowledge of their preferences. To produce a Hybrid System, individual can practice any of the systems:

By evaluating mutually, the outcomes of both, afterward gaining the results separately.

One can program a Hybrid RS by merging Content based recommendation technique in Collaborative Filtering.

One can also program a Hybrid RS by merging Collaborative Filtering based recommendation technique in Content based Filtering. [19]

D. Knowledge-based Recommender Systems: -

When factors like understanding about customer, items and/or their correlation are used to build a system. This kind of recommender technique is called Knowledge-based R.S. K.B.R.S. keep an effective data about how user's demand can be fulfilled by an item which fulfills customer's demand. This can be contented by keeping in account the interactions, about the correlation linking customer's needs and a feasible recommendation. [21]

E. Computational intelligence-based recommendation techniques: -

An artificial neural network (ANN) is a meeting of interconnected nodes and weighted links that is enthused by the architecture of the lively brain and can be used to build model-based recommender systems.[15]

The content sifting portion as for structure remains grounded against skilled A.N.N. constituting separate customer likings. Grouping includes task as for things to cluster in order that stuffs within similar cluster are a lot alike than the items in dissimilar clusters. Grouping can be used to lessen the calculation price for discovering the adjacent neighbors. The unrated items of a separate customer in a cluster can be foreseen by usage of the rating info from a cluster of closely connected customers. Besides, presumptuous that adjacent bystander too must be in Top N utmost alike groups to lively customer, the adjacent bystanders in Top N groups must be selected, allowing the structure to be measurable. The grouping method is used to account the cold start problem in R.S.s by gathering items. Genetic algorithms (GA) stay speculative exploration methods that stay to be appropriate for framework development difficulties through impartial purpose tentative hard & soft restraint. GA-build K-means grouping remains pragmatic to everyday online shopping marketplace separation situation for individualized R.S.s, consequential in better-quality dissection presentation.

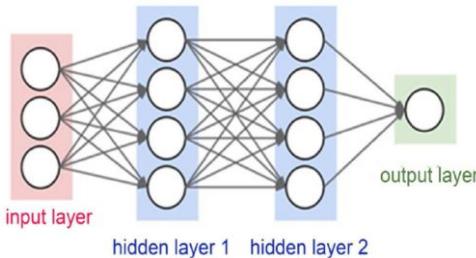


Fig. 2. Artificial Neural Network

F. Challenges and Problems in Recommendation System

There are numerous problems and difficulties which arose during building recommender systems.

Cold-Start: - While building a new RS, the system doesn't have any prior knowledge of user's preferences. The system also does not have any prior familiarity about new items or the items which are never rated by any user. So, the system faces many difficulties while recommending to the users. This problem is called Cold-Start. [11]

Sparsity: - When users does not rate various items, the user-item array turn out to be inadequate and large. When users rate very few items on the internet, the RS faces problem to recommend properly as very few information about users' preferences is available to the system. [11]

Limited Coverage: - For providing recommends to users, many times RS systems compare the ratings of similar kind of users or dissimilar users on analogous type of items. Therefore, if the users have same type of proclivity for usual items then they can be said adjoining. But when user don't rate items, this approach becomes unsuccessful which is termed as Limited Coverage. [11]

Diversity: - If there is multiplicity in recommended items, then the client may discover suitable as well as relevant items. If a user is not getting diversified recommends by the system, then there is no merit to build a RS. [11]

Over-Specialization: -- When users chose preferences, the items are also recommended according to those preferences. So, it narrows down all the stuff present on the internet and only those items are left which are of user's interest. This creates dearth of variation of items in the customer's emprise. This kind of problem is named as Over- Specialization. [11]

G. Advantages of Recommender System

There are numerous edges of Recommendation Systems but some of the greatest significant advantages of RSs system are: Any information that is difficult for machine to automate content analysis, it helps to filter them.

Recommendations Systems can advise new items to users without past predilections of users.

It shares/uses the experience of other users to avoid incomplete or inaccurate filtering.

It has ability to filter items based on complex, hard-to-interpret concepts.[23]

IV. RESULT

The set of data utilized for investigation stays chosen from EachMovie [10]. EachMovie set of data comprise evaluation statistics on 1,500+ movies by 71,000 consumers throughout period of 17+ months from last 5 years. Users rated numerous cinemas by no. of stars from 0 to 5. In this investigation, the ratings are changed to Boolean because in real-world setting this kind of explicit ratings can't be attained simply. It also comprises the labels of movies, category of the cinema, gender of consumers and age of consumers. Foremost, 1900+ consumers with beyond 100 positive rated stuffs were chosen. For each chosen consumer the information is separated in 10 lays, each containing 10 stuffs, and used as training lays.

The data review started through 1 training coordinate (10 stuffs). When every agent suggests 10 stuffs, the controller agent chooses top-10 stuffs amongst them. These stuffs are contrasted to succeeding instruction lay of size 10. If a suggested stuff is coordinated to a stuff in succeeding instructing lay then it is known as positive response, and the agent that suggested stuff is improved as defined in unit 2 by counting entire no. of successes. Then, the size of instructing lay is increased by implementation of 2nd instructing lay. Now, the instructing lay contain 20 stuffs, and after utilizing it, we get new suggestions, and so on.

TABLE I. THE RISE IN THE AVERAGE SUCCESS RATIO AS THE INSTRUCTION LAY SIZE RISES

Method	Instructing Lay Size								
	10	20	30	40	50	60	70	80	90
Without Coordinator	0. 0	2. 5	6. 0	6. 5	8. 0	8. 5	9. 0	10. .5	13. .2
With Coordinator	0. 0	10. .5	29. .0	34. .5	36. .5	43. .0	52. .0	56. .5	66. .5

TABLE II. THE CHANGE OF WEIGHTS FOR EACH AGENT AS THE TRAINING SET SIZE INCREASES

Agent	Instructing Lay Size								
	10	20	30	40	50	60	70	80	90
Content-Based	0.1 5	0.1 3	0.1 3	0.1 3	0.1 1	0.1 1	0.1 0	0.0 9	0.0 9
Collaborative	0.3 5	0.3 8	0.4 2	0.4 5	0.4 8	0.5 0	0.5 1	0.5 4	0.5 5
Demographic	0.4 5	0.4 4	0.4 0	0.3 7	0.3 5	0.3 3	0.3 3	0.3 1	0.3 0

The interpretation of suggestions is scaled as Hit Ratio (% of matches amid suggested stuffs). Hit ratio characterizes the number of suggested stuffs which are ideal stuffs. As the no. of feedbacks on suggested stuffs rises, the performance of total suggestions also rises as the coordinator agent gives more weightage to that agent which receives more positive feedback. As Table 1 depicts, the average hit ratio of suggestions with coordinator agent increased 67% from initial hit ratio 0.15, while the average hit ratio without the

coordinator increased only 13%, as the training set size increased to 90.

Table 2 displays modification in each of the agents. For this set of data, on an average, the C.F.B.R.S.s receives an increase in positive responses, and the C.F. agent increases to 0.55. Contrarily, the C.B.R. decreases to 0.09. The reason is that EachMovie set of data doesn't have sufficient info for demographic agent and C.B.R. agent. The demographic agent discovers neighbors by using gender & age. The C.B.R. agent receives keywords only from the cinema labels; therefore, it always suggests cinemas which consists the words found in the chosen labels. Though, the demographic agent is in peak in initial phase since there is not sufficient data for the collaborative agent.

V. CONCLUSION

In this paper the various ways of building a recommendation system are discussed according to the different needs of users. Detailed information about various Recommender techniques currently in use namely Collaborative Filtering, Hybrid RSs, Content based filtering, Knowledge based filtering and Evolutionary Computing technique are also discussed. The paper also debates about the applications of Recommendation Systems, the challenges involved while building a Recommender system and its pros and cons. In this paper, an Experimental work was also performed by applying the proposed work on EachMovie Dataset. From the experiment we came to a result that with increasing number of feedbacks, there increases the number of Hit Ratio of recommendation systems with coordinator agent. If in N experimental analysis where domain of characteristics is unclear, this experimental work can be helpful. The paper also discusses about the inability of Collaborative Filtering to recommend users without prior information about preferences of users. And to which the use of Hybrid Recommender System in place of Collaborative Filtering to avoid problems like complete cold start and incomplete cold start.

FUTURE WORK

From the above discussion we can say that in Hybrid RSs uses both C.B. and C.F. method, has ample of possibility to give a better Recommendation Systems as they are free from various challenges faced while creating a recommender system. Also, in the field of RSs there is a limited use of AI sets like ANN, Fuzzy Sets, Swarm Intelligence, etc. which might upswing in future years.

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