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An Application on Adaptive E- learning using Semantic Rule based Approach

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Abstract: ***Due to the growth of internet users, E-learning has become a preferred mode of learning not only in distance education but also in colleges and universities. However, most of the E-learning systems provide static web-based learning so that learners access the same learning content through the internet, irrespective of individual learner's profile. These learners may have very different learning backgrounds, knowledge levels, learning styles, and abilities. The "one size fit all" in an E-Learning system is clearly a typical problem. To overcome this limitation and increase effective learning, adaptive and personalized learning method is used.***
The proposed system utilizes the captured learner's information during the registration phase for determining learners' characteristics. The system also tracks learners' activities and tests during the learning process. Results are analyzed in order to calculate learner's abilities. The learner view page is updated based on the result of activities, results of test and learner's ability for use in the adaptation process
Keywords: Adaptive learning; personalized learning, web based learning, Hybrid Recommender system, Association Rule Mining, C4.5 classification Method.

1. INTRODUCTION

Education plays a key role for the development of an individual and Learning is an integral part of education. It is a process of acquiring Knowledge and skills. In today's information rich world, it is not only intended to make information available for the learner in any form at any time, but also offer right content to the right user in right format [1]. It is believed that every individual learns according to own intrest, experience, style and need [10] [1]. Adaptive learning is a learning method that dynamically adapts learning content to learner's educational needs. To provide adaptability, information is collected from the students by asking some questions, based on their knowledge and background details and then mining algorithm process these input data and gives the resultant page to the learner. This is as an effective method of individualized learning [2] [10].

In the proposed paper, we have used two data mining techniques, classification mining and association mining to find set of recurrent behavior that can be found within a learning process. Initially a set of questions are displayed on screen to check learner's knowledge about the subject and their personal profile, the information provided by users act as input Dataset. As a result, suitable learning pattern is discovered by both the mining algorithms and the related pages will be displayed to the learners. All the mining algorithm uses different methods to find suitable content. The proposed adaptive software has C4.5 classification algorithm, and hybrid mining an association mining algorithm. Rest of the paper is structured as follows. Section (2) describes the semantic rule that is applied to data to get desired result Section (3) describes the classification and association mining algorithms. Section (4) shows results and analysis comparing data mining C4.5 and Hybrid Association Mining algorithm. Section (5) includes conclusion and future work.

2. Semantic Rule for Learning

While developing any adaptive learning software or web sites the key challenge is to build effectively represented user's profile, learning style and behavior that supports reasoning about each learner [1][3]. As the time passes state of learners get changes, so the application should also dynamically update state of learner and their information. Adaptive learning application does the task of matching learners profile with solution that fits their learning requirement.by generation of rules while learning. Semantic Rules generally helps in monitoring change in user's behavior while learning.

3. Data Mining Algorithm

To get the best fit result in adaptive learning based on user's profile and knowledge, we used C4.5 Classification Mining Algorithm and Hybrid Association Mining Algorithm.

C4.5 algorithm: It was developed by Ross Quinlan to generate decision tree. It handles both continuous and discrete values, missing values and pruning trees after construction [4][5][11]. C4.5 is a supervised learning algorithm, that analyzes training set and build a classifier that must be able to correctly classify training and test example. The input to the algorithm is set of examples and

the output is a decision tree and a set of rules that assign a class to a new class.
At each node of the tree, C4.5 chooses the attribute of the data that most effectively splits its set of samples into subsets enriched in one class or the other. The splitting criterion is the normalized information gain (difference in entropy). The attribute with the highest normalized information gain is chosen to make the decision. The C4.5 algorithm then recurs on the smaller sub lists.

Algorithm. C4.5 is implemented recursively with the following sequence.

1) Check if algorithm satisfies termination criteria.
2) Computer information-theoretic criteria for all attributes.
3) Choose the best attribute according information theoretic criteria.
4) Create a decision node based on the best attribute in step 3
5) Induce (i.e. split) the dataset based on newly created decision node in step 4
6) For all sub-dataset in step 5, call C4.5 algorithm to get a sub-tree (recursive call)
7) Attach the tree obtained in step 6 to the decision node in step 4
8) Return tree.

Association Mining:
Association mining is used to find frequent patterns, correlations, association or casual structures from different data bases. Association rules are created by analyzing frequent pattern and using criteria support and confidence, where support indicates how frequently item appear in database [14] [5]. Confidence indicates the number of time if/else statement have been found to be true.

Hybrid Recommender:
the proposed system uses another mining technique called hybrid recommender system that integrates association rule mining with content based approach. Recommender systems are used to find useful information. It does the job of collaborative filtering and content based filtering [6] [9][13]. Hybrid recommender system combines two or more approaches to gain better performance and remove the drawback of pure recommender system approaches. [7][8][12]. Our system used Demographic and Collaborative Filtering Recommender system [8][5] [12] to generate set of Association Rule, that gives minimum support count and minimum confidence [14][5].

Collaborative Filtering:
Collaborative Filtering is a domain independent prediction technique for content that cannot easily and adequately be described by metadata such as movies and music [7][8] [12]. Collaborative filtering works by building a data base of preferences for item by users. It then matches users with relevant interest and preferences by calculating similarities between their profiles to make recommendation. Such users build a group called neighborhood. user gets recommendation to those item that he has not rated before but that were already positively rated by users in his neighborhood [9] [13] [14].

Demographic Filtering:

A demographic-based recommender system recommends items to the user based on the user's demographic information such as gender, age, and date of birth, Qualification, job profile [7][8]. The demographic approach puts the users into groups based on their demographic characteristics [13] [14]. The recommendation systems based on demographic approaches assume that the users in the same group or category share the same interests and preferences [9].

4. Results Analysis

In this paper we propose an approach for learning that is capable of analyzing and understanding user's demands, behaviors and characteristics from large databases. Firstly, the paper constructs user's demand domain ontology and user's demand discovery task ontology. Further, the paper provides ontology based data mining framework, which is implemented for mining user's data from the case firm and knowledge extraction from data mining results is illustrated as knowledge patterns and rules. Our study provides a way to conduct user's demand data mining and facilitate decision making.

RESULTS AND DISCUSSIONS
Performance Evaluation
For accurately evaluating our system, there is a need of metrics which measure the actual performance of our system.
Evaluation Metrics
In any adaptive learning system, it is very much important to retrieve near precise answers which will fulfill the needs of user search.
Manual Testing
Accuracy:
Accuracy is defined as the ratio of number of sentences for emotion labels are extracted correctly to the total number of sentences in the document.
Accuracy=

$$\frac{number\ of\ attempt\ for\ which\ recommendation\ extracted\ correctly}{total\ number\ of\ attempt\ for\ which\ recommendation\ extracted\ by\ algorithm} * 100$$

Table 1: Data Set for the proposed system.

Profession	Known_Prog_Languages	Certification_done	Experience	Need_Of_Programming	OOP	Basics	Platform_Depende	Syntax	Loop	Conditional_State	Function_And_Cla	Arrays	File_Handing	Rating_Yourself	File
Programmer	c,c++,java	no	no	knowledge	yes	yes	Yes	yes	yes	yes	yes	yes	yes	5	python1.html
Programmer	c,c++,java	no	no	knowledge	yes	yes	Yes	yes	yes	yes	yes	yes	no	4	python2.html
Programmer	c,c++,java	no	no	knowledge	yes	yes	Yes	yes	yes	yes	yes	no	yes	4	Python3.html
Programmer	c,c++,java	no	no	knowledge	yes	yes	Yes	yes	yes	yes	yes	no	no	4	Python4.html
Programmer	c,c++,java	no	no	knowledge	yes	yes	Yes	yes	yes	yes	no	yes	yes	4	Python5.html

Below are the test cases created for proposed paper:

Table 2: Test Cases

Test cases	Total No. of input	Total No. of output	Total no. of correct output	Accuracy (%)
Test case 1	60	60	54	90
Test case 2	100	100	91	91

Field wise Accuracy = Total column wise accuracy / Total no of fields

=93.81%

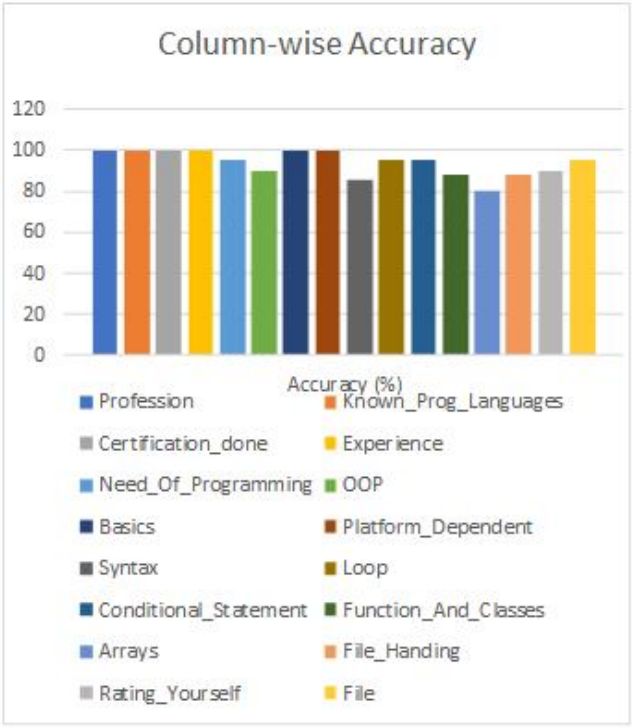

Fig 1: Colum wise Accuracy

Precision and Recall

To measure the quality of adaptive learning system, precision and recall are used as most common measures. Recall provides percentage of solutions found whereas precision provides fraction of all solutions found correctly. Precision specify exactness of system whereas recall provides correctness of system. High precision regarding a system indicates that system found more relevant answers than irrelevant whereas high recall indicates system extracted most of the relevant answers present in the system.

Precision and recall can be easily defined using a contingency table where TP indicates number of true positives; FP indicates number of false positives, TN indicates number of true negatives and FN indicates number of false negatives.

(TP) True positives are test data that are correctly found as expected result.

Programmer	c,c++,java	no	no	knowledge	yes

yes	yes	yes	yes	yes	no	no	yes	4	python2.html

(FP) False positives are test data that were found by the system as expected but actually are listed in the unexpected ones.

Here some fields are different at the time of input and we are getting different output but present in database.

Programmer	c,c++,java	no	no	knowledge	yes

yes	yes	yes	yes	n	yes	no	no	3	python2.html

(FN) False negatives are test data not found by the system. Here no data are found as we are expecting output.

(TN) True negatives are the test data correctly found as unexpected by the system.

Programmer	c,c++,java	Yes	no	knowledge	yes

yes	yes	yes	no	n	yes	no	yes	3	python2.html

Here we are expecting some different output but system found exact pair for the input.

Table 3: Performance Evaluation

Total no. of test data checked	T
Total no. of test data found correctly as expected result	TP
Total no. of test data found wrongly as expected result	FP
Total no. of test data not found but are expected result	FN
Total no. of test data found correctly as unexpected result	TN

Recall = TP/ (TP + FN)

Precision = TP / (TP + FP)

Accuracy = (TP + TN) / (TP + FP + TN + FN)

Total no. of test data checked	100
Total no. of test data found correctly as expected result (TP)	80
Total no. of test data found wrongly as expected result (FP)	5
Total no. of test data not found but are expected result (FN)	6
Total no. of test data found correctly as unexpected result(TN)	8

Table 4: Performance Evaluation for C4.5 Classifier

Recall = TP/ (TP + FN)

Precision = TP / (TP + FP)

Accuracy = (TP + TN) / (TP + FP + TN + FN)

Recall measure of the system =80/ (80 + 6) = 93.02%

Precision percentage of the system =78 / (78 + 5) =94.11%

Accuracy percentage = (78 + 7)/ (78 + 7 + 8 + 7) =88%

Table 5: Performance Evaluation for Hybrid Recommendation

Total no. of test data checked	100
Total no. of test data found correctly as expected result (TP)	84
Total no. of test data found wrongly as expected result (FP)	4
Total no. of test data not found but are expected result (FN)	5
Total no. of test data found correctly as unexpected result(TN)	7

Recall = TP/ (TP + FN)

Precision = TP / (TP + FP)

Accuracy = (TP + TN) / (TP + FP + TN + FN)

Recall measure of the system =84/ (84 + 5) = 94.38%

Precision percentage of the system =84 / (84 +5) = 95.45%

Accuracy percentage = (84 +7) / (84 +4 +5 +7) = 91%

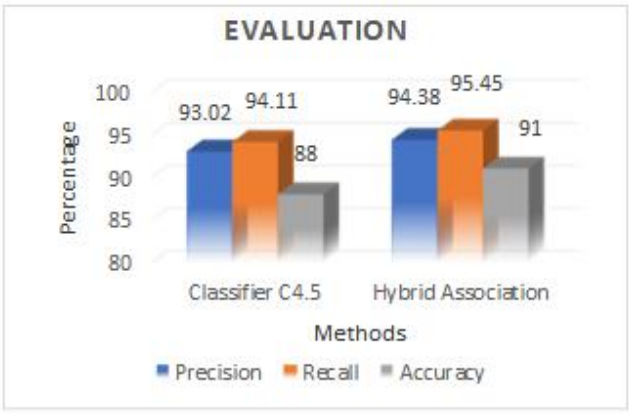

Fig: 2 Accuracy of Data Mining Algorithms

5. Conclusion and Future Work

There has been a big gap between the extraction of useful patterns from data sources to knowledge, as it is crucial that data is made valid, novel, potentially useful and understandable and this process don't happen automatically. The practices as described in this paper is of great importance in bridging the gap between the levels of learning for different users by providing them with the same learning opportunity, through a system that adaptively

support the personalization of contents for learning based on data regarding the users learning behaviour or Actions.

In the proposed Paper we have used two data mining techniques and calculated their accuracy on different parameters. As per the analysis result we have found that Hybrid Association mining is comparatively showing more accurate result then C4.5 classification algorithm. Though C4.5 algorithm has many advantages, but Hybrid Association Mining Recommendation technique provides more personalized Pages to the learner.

The proposed data mining algorithms are having 88% and 91% accuracy. In future we will use other data mining techniques which can have more accuracy, to show more personalized pages for a better learning experience.

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