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Evaluation of multimedia micro-courses based on augmented reality technology Bayesian network

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Abstract. The multimedia micro-course is a professional basic course, having a very strong practicality and requiring the teacher to combine the theory with the practice to give lessons, this paper proposed one kind of evaluation of multimedia micro-Course based on the augmented reality technology Bayesian network. In this paper, the concept of the multi-branches tree of attribute in DDMB and the idea of reflecting the general characteristics of the data sets in the distributed environment through the multi-branches tree of attribute are expounded. This paper has introduced the method of constructing Multi-branches tree of attribute based on mobile agent access distribution Data Set, and specifically described the algorithm of generating integrated Bayesian network through multi-branches tree of attribute . The structure Learning and parameter learning of Bayesian networks oriented to multi-branches tree of attribute and the method of determining the minimum threshold of dependent coefficient between attributes have been expounded. The experimental results show that, the model can effectively solve the problem of heavy learning burden, high storage cost and low executive efficiency of the original distributional environment Bayesian network, and has realized a more effective multimedia micro-course evaluation.

Key words. Augmented reality, Bayesian, Micro course, Multimedia, Course evaluation.

1. Introduction

Multimedia Micro-course is a combination of theory and practice, it is highly practical; the teaching quality of the course multimedia micro-course plays a very important role in the realization of the goal of talent cultivation, and an objective and accurate evaluation of the teaching quality of multimedia micro-course has a positive and important significance for improving the teaching quality of multimedia

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micro-courses.

There are many factors affecting the teaching quality of multimedia micro-courses, and it is difficult to quantify them, the relationship between evaluation index and evaluation result is complex and non-linear, it is difficult to evaluate the teaching quality of multimedia micro-course accurately and objectively. Zhang Li et al have made a fuzzy comprehensive evaluation on the teaching quality of multimedia micro-courses, and it was necessary to establish a complex mathematical model in the process of evaluation, and the acquisition of index weight is somewhat subjective, while the Bayesian network can do without understanding and establishing a complex mathematical model to describe this mapping relation, it can find its rule from the numerous and complicated data of unknown pattern by the learning and training with a sufficient input of samples, overcoming the influence of man-made subjective factors, and establishing a correct input-to-output mapping relation, so as to make the result of evaluation more objective and effective.

This paper presents a method of evaluating multimedia micro-course based on augmented reality Bayesian network. It can effectively solve the problem of heavy learning burden, high storage cost and low executive efficiency of the original distributional environment Bayesian network, and has realized a more effective multimedia micro-course evaluation.

2. Establishment of evaluation index

The multimedia micro-course teaching quality evaluation index system directly embodies the objectivity, rationality and impartiality of the evaluation result, so the establishment of a scientific, systematic and effective teaching evaluation standard and Index system is the key to teaching evaluation. The evaluation index system should be established on the basis of the Teaching Quality Evaluation Index system of multimedia micro-courses for colleges and universities with the consideration of characteristics of multimedia course of the university itself.

Evaluation index should be designed based on the different perspectives of main body of evaluation, which generally are the experts and the students, the evaluation index should be timely, oriented and visualized, it cannot be too indistinct and fuzzy, according to actuality of the university's multimedia micro-course, the expert's evaluation has focused on the configuration of curriculum software and hardware, teaching preparation and the information completion, ability to organize the classroom order, the way of expression in teaching, degree of coincidence with teaching objectives and course orientation, level of professional theoretical knowledge and practice, knowledge renewal and expansion, evaluation methods and results, etc. ; while the student evaluation focuses on the degree of devotion by teacher to the classroom, the sense of responsibility over students, and whether they lay emphasis on inspiring students and cultivating their innovative ability, whether the student's knowledge and ability level are improved through the teaching, teacher extracurricular investment, intra-curricular and extracurricular guidance and exchange to students and so on.

Table 1. Multimedia microcourse teaching quality evaluation index

Primary index	No.	Secondary index
Pre-class preparation	$X1$	Whether the construction of teachers' team is reasonable
	$X2$	whether the hardware facility is complete and suitable
	$X3$	Whether the syllabus, the teaching plan and the teaching plan are complete
	$X4$	Whether the teaching meets the requirements of the syllabus and whether it meets the professional needs in accordance with the teaching progress
classroom teaching	$X5$	Whether the Lecture is clear and easy to understand and simple, whether the key and difficulty are definite, whether the content is substantial with a large amount of information
	$X6$	Whether The use of multi-media means in teaching process is skillful and reasonable
	$X7$	Whether the classroom order is effectively organized, whether the students are inspired and encouraged to think, innovate and participate in the teaching process, and whether the classroom atmosphere is animated
	$X8$	Whether the teacher updates and expands the textbook content in a timely manner and recommends effective reference materials?
	$X9$	Whether the teaching is based on project case
	$X10$	Whether the teacher teaches combined with a practice, whether the operation is skillful
	$X11$	Whether the time of computer practice of students is proportional to the time of teacher teaching
	$X12$	Whether the Teacher's instruction to students on computer operation and after-school learning are adequate, whether the difficulty of exercise and assignment is moderate, and whether there is a network guidance
	$X13$	Whether various (such as papery, electronic edition) teaching materials, exercises and guidance materials are provided for students independent study
	$X14$	Whether the students are more interested in the course, whether a work style that is rigor and meticulous is developed
teaching result	$X15$	Whether the students can use software skillfully
	$X16$	Whether the student's basic theoretical level, configuration-structure ability and innovative thinking is improved
	$X17$	Whether the student's independent study ability is improved
	$X18$	Theory test grade
	$X19$	Computer practice exam grade
	$X20$	Regular assignment

The teacher is the main body of the teaching organization, the teacher's teaching method, teaching attitude and knowledge capability directly influence the teaching quality. Therefore, this paper, based on the process of teaching organization by teacher, classifies the above indexes based on different angles to form 3 primary indexes, according to the principle that index establishment should be timely, oriented and visualized, centered on the main objective of cultivating the innovation consciousness and the innovative thinking ability of student, 20 secondary indexes were developed and optimized based on the study by Zhang Yunling et al. The specific index system is shown in table 1.

3. Distributed data mining model DDMB based on augmented reality Bayesian network

Aiming at the networked database formed with the multimedia micro-course teaching quality evaluation, by the use of Agent's mapping of characteristic attribute of distributed data source and Bayesian network learning method, this paper establishes a distributed data mining model oriented to the teaching quality evaluation and analysis of multimedia micro-courses, and supports the decision-making activities such as quality evaluation and prediction in regard to multimedia micro-course. The main ideas about DDMB model proposed in this paper are: Using the mobile Agent to access the distributed data set to construct the multi-branches tree of attribute, analyzing and determining the dependent coefficient between all attributes, generating a Bayesian network formed by a combination of multi-branches tree of attribute and dependent coefficient, Figure 1 shows the system structure of distributed data mining model DDMB.

In Figure 1, the Mediation Agent is a mobile agent, which has the characteristics of autonomy, reactivity and initiative, its task is to analyze and generate the multi-branches tree of attribute from the distributed database, this tree is a set of characteristic values of the decision-making content attribute. The analysis process of the DDMB model is as follows: The autonomous Agents firstly position the corresponding DBi, each of them accesses the record of the contents related to decision making in the DBi, and extracts the DBi's attribute value, then invokes the multiple-branches tree generating algorithm to generate the multi-branches tree of attribute, and then generates a comprehensive Bayesian network through this multi-branches tree of attribute via the improved Bayesian structure and parameter learning.

3.1. multi-branches tree of attribute

Multi-branches tree of attribute is a multi-branches tree with a header table, in which each layer of nodes in the tree corresponds to a certain attribute in the dataset except for the leaf node, and attribute is a certain field related to the decision-making content. Each side of the tree corresponds to a value with different attribute, that is, the number of sides a certain attribute has is the number of valuing it may have. Each node holds the attribute values for the corresponding side and the number of records that satisfy the values. Fig. 2 is an example of some multi-branches tree of

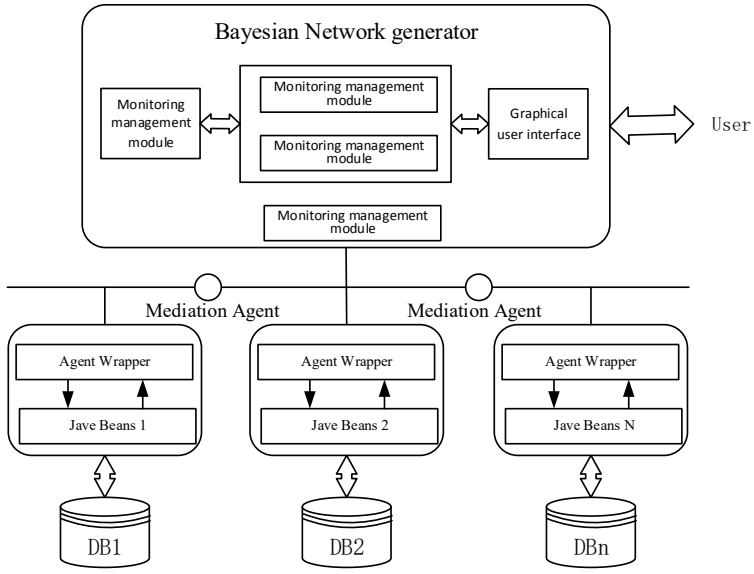


Fig. 1. System structure of DDMB model

attribute in the course of classification of multimedia micro-courses teaching using Bayesian network.

The second layer denotes the attribute of Age (evaluated value), corresponding to the 3^{rd} side, each side corresponds to the three valuing, ">=40"‘ <40 and >25"‘<=25", each node holds a certain valuing and number of records, such as, in 1440 records of "non-card user", there are 430 evaluated values that are more than or equal to 40, there are 611 evaluated values that are less than 40 and more than 25, there are 399 values that are less than or equal to 25.

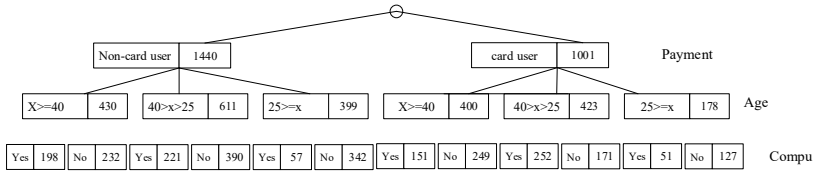


Fig. 2. Example of Multi-branches tree of attribute

The header table of Multi-branches tree of attribute is an index structure that is oriented to node search, providing support for the dynamic operation of Multi-branches tree of attribute by Agent. As shown in the Fig.3, the header table includes three fields: attribute name AttName, attribute valuing AttValue, and the head pointer of chain table Head. Each line in the head table records a valuing of an attribute, and all the nodes that have the same valuing in each attribute are linked by a chain table, and the head pointer is put into the head table.

When Mediation Agent moves to the distributed dataset DBi, the information

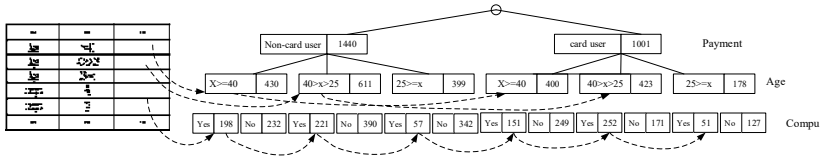


Fig. 3. Head table example of Multi-branches tree of attribute

of every tuple that has been accessed in the database can be dynamically saved in the multi-branches tree of attribute, and the nodes and their corresponding values are increased and decreased in the multi-branches tree of attribute. When each Mediation Agent moves the dataset it corresponds, the sides and nodes of multi-branches tree of attribute are modified, so that the multi-branches tree of attribute is obtained.

Multi-branches tree of attribute is used to mirror the attributive character of distributed data source, and avoid the network and storage burden associated with distributed data aggregation. The Multi-branches tree of attribute only records the attribute eigenvalues in the distributed data source which are related to the decision-making, that is, the value of each attribute and the number of records that meet the condition of the given attribute value, needless to save the information of whole record, so the network and memory space are saved and the improvement of efficiency of the operation is facilitated. Based on this Multi-branches tree of attribute, and combined with Bayesian Network learning algorithm, a Bayesian network reflecting the overall characteristics of the distributed data source is obtained, and the distributed data mining is realized.

3.2. Bayesian Network augmented reality structure learning

After the Mediation Agent accesses the distributed data source and generates the multi-branches tree of attribute, the structure learning algorithm based on correlation analysis is used to obtain the Bayesian network structure. The key to this algorithm is to compute the dependency coefficient G (Vi, Vj) between all attributes according to the multi-branches tree of attribute, and to input the minimum threshold value determined by experience, then the integrated Bayesian network structure in a distributed environment can be obtained. The calculation method and the related explanation of the dependency coefficient G (Vi, Vj) between all attributes are given as below, in which the Vi and Vj correspond to the attribute of layer i and j shown in Fig. 2.

Definition 1: assume S is a set of s data samples, and assume Vk attribute has m different values, m different kinds are defined as Ci (i=1, ..., m). assume s_i is the number of samples in the kind Ci, then expected information is :

$$I(V_k) = \sum_{i=1}^{m} P_i Log_2(P_i)\,.$$

Where Pi is the probability that any sample belongs to Ci, and it is estimated by s_i/s; due to the information binary coding, the log function is based on 2 [1].

Definition 2: assume the attribute Vk has v different values $\{a_1\ a_2 \ldots\ldots a_v\}$, Vk divides S into v subsets $\{S_1, S_2, \ldots, S_v\}$; where Sj includes such samples in S, they have a value aj on Vk; assume $s_{ijisthenumber}$of samples that the subset Sj has in the kind Cj, then:

$$I(V_{k+1}|V_k) = \sum_{j=1}^{v} \frac{s_{1j} + \cdots + s_{mj}}{s} I(s_{1j}, ..., s_{mj})\,.$$

Where, $I(s_{1j}, \ldots, s_{mj}) = \sum_{i=1}^{m} P_{ij} Log_2(P_{ij})$, $P_{ij} = \frac{s_{ij}}{|S_j|}$ is the probability that the samples in Sj belong to kind Ci [1].

Algorithm 1: Calculation of dependency coefficient G (Vk, Vk+1) between two adjacent attributes using multi-branches tree of attribute .

Input: one multi-branches tree of attribute (AttiTree); output: $G(V_k, V_{k+1})$

Method: calculate $I(V_{k+1})I(V_{k+1}|V_k)G(V_{k+1}, V_k) = I(V_{k+1}) - I(V_{k+1}|V_k)$

according to the order of sequence using the information related to Vk in head table.

Algorithm 2: Calculation of dependency coefficient G (Vk, Vk+1) between any two attributes using multi-branches tree of attribute .

Input: one multi-branches tree of attribute (AttiTree); output: dependency coefficient between any two attributes.

Method: calculate the dependency coefficient between all the attributes represented by adjacent layers;

```
For k=1 to n-1
  Begin
    copy an original AttiTree, denoted by AttiTree';
    delete the first k-1 layers before AttiTree';
      For j=k+1 to n-1
        Begin
          Delete the 2nd layer of AttiTree';
    Calculate the dependency coefficient between the 1st layer and 2nd layer
of attribute in the AttiTree after modification;
End
End
```

The dependency coefficients between different attributes are obtained by algorithm 1 and algorithm 2, then the complete graph G containing all the attributes is constructed, the minimum threshold ε is input, and all the sides in G that have an dependent coefficient less than ε are removed, and the structure G ' of the Integrated Bayesian network is obtained.

3.3. Parameter learning of Bayesian network oriented to multi-branches tree of attribute

After the structure of Bayesian network is determined, the maximum likelihood estimation statistical method is used to compute the parameter table (CPT) of each node in Bayesian network structure by the use of the multi-branches tree of attribute. The basic idea is to judge the fitting degree of the data sample and Bayesian network model according to the degree of likelihood between the data sample and the model parameter. The specific implementation process is realized through the multi-branches tree of attribute and Bayesian network digraph and calculating the CPT of each node respectively, querying the different values of each layer of attribute in the Multi-branches tree of attribute and the corresponding number of branches, the probability value of each item in CPT is calculated by dividing the number of branches of valuing of this attribute by the number of branches of valuing of the parent node attribute. The calculation process is shown by the algorithm 3.

Algorithm 3: multi-branches tree of attribute is used to compute the CPT that each node corresponds in the network.

Input: one multi-branches tree of attribute (AttiTree); one Bayesian network digraph.

Output: CPT corresponded by each node in the digraph.

Method: For each attribute Vk

Begin

Copy a multi-branches tree of attribute

Delete the number of layers that are corresponded by attributes that are above Vk and not the parent node of Vk;

For a node on the layer k

Begin

A conditional probability is added into CPT, the condition is the valuing of each attribute on the path from the root node to node, the assertion is the mark of Vk is valued as E, the probability is the value on E divided by the value on the side pointing to node;

End

End

3.4. Process of building Bayesian network

The whole process of building Bayesian network in data distributed environment, as shown in the Fig.4.

In practical applications, the attributes related to the application purpose should be screened according to different application purposes (multimedia micro-course teaching classification, multimedia micro-course teaching prediction, etc.), and then the integrated Bayesian network in Distributed data source environment is constructed by using the above model, and this integrated Bayesian network can be used to predict and classify.

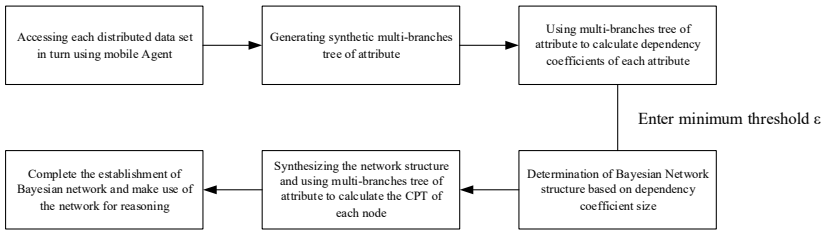


Fig. 4. The whole process of building Bayesian network in data distributed environment

4. Experimental analysis

4.1. Obtainment of data

This paper makes a questionnaire based on the indexes listed on the bottom level in Table 1, the questionnaire takes the form of choice question, and the choice is set based on the degree of the indexes themselves, such as, specific to the index distinct key points, it can be set as, whether the teacher is clear about the key choice questions during class, the choices are A, all the key points are carefully explained; (B) Emphasis is placed on individual key point; C, no key point generally, waiting for student's question, D, no key point at all, unclear even if students raise questions . Basically each index can be used to set 2 choice questions, in order to be able to quantify the final results of the questionnaire, it may be set that, choice A means 4 points, B means 3, C means 1 and D means 0. When there are multiple choice questions for an index, the corresponding choices may be added together. The aim of doing so is to reduce the subjective arbitrariness caused by free scoring.

The questionnaire was completed by the expert teachers and students of the school, and finally 10 questionnaires of experts were collected, and the questionnaire filled by expert teachers was quantified and used as a training sample. The reason why the expert teacher's sample data is used to train the network is that, the expert teacher is rich in experience, their thought is more mature and objective, and they have a deep understanding of the objective and status quo of the multimedia micro-course, so the expert teacher's evaluation can reflect the final result.

171 questionnaires filled by students were collected, through screening, it was found that there were 43 questionnaires in which all the questions were answered with choice A or answered sloppily, so these 43 questionnaires were not used as sample data, out of the remaining 128 questionnaires, 5 were selected as test sample, the other 123 questionnaires were used as an evaluation sample. In addition, in order to speed up the convergence speed of the network, the results of the questionnaire are quantified and normalized, and the processing formula is:

$$x_i^* = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} .$$

Where, x_i^* is the input data after processing; x_i is the input data before process-

ing; $x_{\min}$ is the minimal value among the input data; $x_{\max}$ is the maximal value among the input data.

4.2. Establishment and test of evaluation model

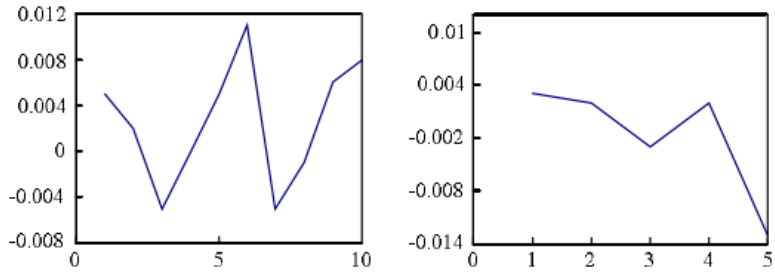
Input the first 10 sets of training sample data in table 2 according to the above steps, the results are presented in table 2, and the error curve is shown in Fig. 5 (a), and the results show that the network output value are basically consistent with the expected output value (the expert evaluation value); the last 5 sets of test sample data are input to verify the evaluation effects of the model, of which the result is shown in table 3, The error curve is shown in Figure 5 (b), the results show that the error of the test sample is very close to that of the training sample, the network evaluation result is consistent with the expert evaluation result, the error is small, the precision is high, so the evaluation model that has been established is reasonable, and it can precisely reflect the teaching quality of multimedia micro-courses .

Table 2. Result of evaluation of teaching quality of multimedia micro-course

Sample	$X1$	$X2$	$X3$	$X4$	$X5$	$X6$	$X7$	$X8$	$X9$	$X10$	...	$X20$	Expert evaluation value	Network evaluation value
1	1	1	0.875	1	1	1	0.875	1	1	1	...	1	0.88	0.875
2	1	0.875	1	1	1	1	0.875	0.875	1	0.875	...	0.875	0.79	0.788
3	1	0.75	0.875	1	0.875	0.875		1	0.75	0.75	...	0.875	0.61	0.615
4	1	0.75	0.5	1	0.75	0.75	0.875	1	0.75	0.5	...	1	0.12	0.120
5	1	1	1	1	1	1	0.875	1	1	1	...	1	0.90	0.895
6	1	0.875	1	1	1	0.875	0.875	0.875	1	1	...	1	0.79	0.769
7	0.875	1	0.875	1	1	0.875	0.875	0.875	1	1	...	1	0.63	0.635
8	1	1	1	1	0.875	0.75	0.5	0.625	0.75	0.5	...	0.5	0.56	0.561
9	1	0.875	0.875	1	0.875	0.625	0.625	0.875	0.625	0.875	...	0.875	0.52	0.514
10	1	0.875	0.875	1	1	0.875	1	0.875	0.875	0.875	...	0.875	0.46	0.452
11	1	1	1	1	0.875	0.875	0.875	1	0.875	1	...	1	0.84	0.837
12	1	0.875	0.875	0.875	0.75	0.875	0.875	0.875	0.5	0.5	...	0.5	0.78	0.798
13	0.875	1	0.875	0.875	0.875	0.875	0.75	0.875	0.875	1	...	1	0.67	0.673
14	1	0.75	1	1	1	0.875	0.875	0.875	1	1	...	1	0.56	0.558
15	1	0.875	0.875	0.875	0.5	0.875	0.75	0.5	0.5	0.75	...	0.75	0.31	0.323

Table 3. Table of contrast between test result and expert evaluation result

Sample No.	1	2	3	4	5
Network evaluation value	0.837	0.798	0.673	0.558	0.323
Network evaluation result	Excellent	Good	Moderate	Pass	No pass
Expert evaluation value	0.84	0.78	0.67	0.56	0.31
Expert evaluation result	Excellent	Good	Moderate	Pass	No pass



(a) Training sample error curve (b) Test sample error curve

Fig. 5. Error curve chart

5. Conclusion

This paper presents a method of evaluating the multimedia micro-course based on augmented reality Bayesian network, and specifically describes the algorithm of generating integrated Bayesian network from multi-branches tree of attribute, and it expounds the structure learning and parameter learning of Bayesian network oriented to multi-branches tree of attribute, and the method of determining the minimum threshold of dependency coefficient between attributes, and on this basis, an effective evaluation of multimedia micro-courses has been realized. The experimental results show that this model can effectively solve the problem of heavy learning burden, high storage cost and low executive efficiency of Bayesian network in the original distributed environment, and realize a more effective multimedia micro-course evaluation.

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