Research of Personalized Web-based Intelligent Collaborative Learning

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***Abstract*—At present, The network collaborative learning in education has been widely used, but they have some problems were not resolved, which like lacks intelligence or can not accurately master information requirements. In the research, using intelligent agent technology in the field of distributed artificial intelligence, to propose a model in collaborative learning process. The model based on the learner's cognitive level, learning ability, cognitive ability, can adjust teaching methods, teaching strategies, achieve individualized to help the user personalized distance learning. Introduce intelligent agent technology, to construct a master program, student agent, teaching agent and collaborative learning model of intelligent agents**

***Index Terms*—Agent, machine learning, data mining, personal study, ant swarm Algorithm**

I. INTRODUCTION

Collaborative learning is a form of group or team by organizing students to learn a strategy. Team members work together to achieve the class an integral part of learning objectives. Collaborative activities in the individual group can be in the learning process of exploration, discovery of information and learning materials, and other members of the group share [27]. Collaboration in Web-based distance learning environment for collaborative learning [19], which has the following advantages:

- Learning space constraints can be broken by Hypertext network collaborative, so that learners learn in their own space [13].
- Cooperative learning so that students can get from other students at the different ideas, opinions, and thus have different learning material point of view, on a deeper understanding of material [5].
- Working in groups, often make people have a higher motivation, because people always want the best in front of others performance [9]. The collaborative learning so that learners can also participate in the team has a sense of identity and belonging [20]. These needs interact with their peers before they can produce psychological needs, is the traditional distance learning environments are lacking [2].

At present, even though the network collaborative learning in distance education has been widely used, but they have some problems were not resolved, including the following:

- Can not effectively implement collaborative group, to meet the needs of learners [4, 18, 33].
- Lacks intelligence, based on different requirements of different students and different courses by phase. With teaching strategies, it is difficult to achieve individualized [14].
- Can not accurately master user's information requirements and user requirements are not well adapted to changes [1, 6, 35].

We designed a model in collaborative learning process, according to the learner's cognitive level, learning ability, cognitive ability to adjust teaching methods, teaching strategies, to achieve individualized; help the user personalized distance learning. This research focuses on the following aspects:

- Introduce intelligent agent technology in the field of distributed artificial intelligence, to construct a master program, student agent, teaching agent and information agent network of collaborative learning model of intelligent agents.
- Intelligent agent based on the students clustering algorithm based on ant colony, according to the learner courses were selected, curriculum concepts, reception, thinking bias achieving the user clustering, obtain different agent group collaborative learning. To stimulate student’s interest in learning and motivation, prompting them to understand and master knowledge and creative spirit, conduct extensive and in-depth study.
- Teaching agent is not only responsible for monitoring the learning behavior, provide teaching resources, but also for the different cognitive levels of learners, using fuzzy neural network method to select the appropriate teaching methods to help learners complete the learning and achieve individualized .

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II. THE MODEL DESIGN BASED ON INTELLIGENT AGENT FOR WEB COLLABORATIVE LEARNING

A. The model design base no mutil-agent for web collaborative learning system

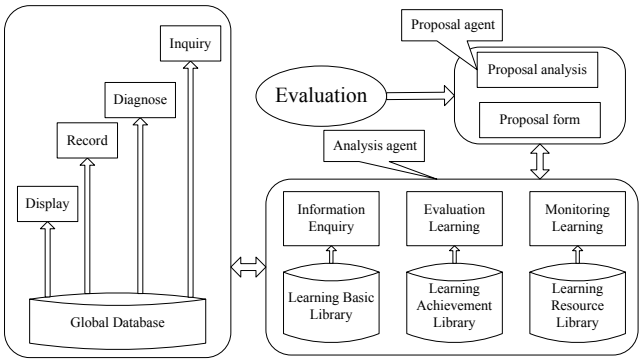

Figure 1. The model design base no mutil-agent for web collaborative learning system

The whole model is divided into three parts: interface agent, analysis agent and proposal agent [22].

- Interface agent: Responsible for direct communication with the users. Interface agents are made with a user dialogue models and images through the interface database.
- Analysis agent: Analysis data of user that obtain from diagnose record, display with the three sub-agent, and send the results into the learning basic library, learning achievement library and learning resource library.
- Proposals agents: Analysis proposals agent access to the contents of the agent library, and then evaluate agent to analyze the differences between learners, the proposed agent based on these differences to the different learners in different teaching methods.

In this multi-agent system, agent for the reduction of direct communication between, so to be placed in the interface agent to communicate information to the global database, master program control related modules, master control program agent can also create a separate module.

B. Intelligent agent technology in web collaborative learning

At present, in the network teaching system, the intelligent agent applies mostly take the software model as foundation, what is more focused on realizes intelligent agent's cooperation, the mobility, the security, as well as MAS system interior mutual union. According to the function of each agent, Online-teaching system can be divided teaching agent, management agent, accompany study agent, search agent, communications and other agents. These intelligent agents play a role mainly in five: real-time monitoring, teaching analysis, information filtering (recommended), collaborative learning and intelligent reasoning.

- Real-time monitoring: As time and space differences lead to a lack of effective and timely guidance, students in the learning behavior is totally dependent on self-regulation. Using intelligent agent technology enables the monitoring of student learning behavior.
- Teaching analysis: Teaching analysis is an important part of intelligent agent, which acts through the analysis of student learning, science teaching strategies to provide smart solution to the students in the learning process problems, help students to complete learning tasks independently. With teaching analysis using intelligent agents, students may at any time confused their own problems, and teachers can check their own knowledge base agents will be presented to the students the correct answer.
- Information filtering: Intelligent Agent system has the network information filtering and information recommendation features. Network teaching, learners are often faced with vast amounts of information loss. Learners not only a waste of time, and not conducive to the learner's specific learning. Collaborative learning: The use of intelligent agent technology, each learner has a corresponding agent, learners and other learners via a proxy agent for communication [7, 12, 34], information exchange and collaborate work to help teachers and learners to study distribution and find the right partner to incentive to carry out collaborative learning.

C. Collaborative learning network model of intelligent agent applications

Using intelligent agent technology, a number of cases in the study and research, based on the play to the advantages of intelligent agent technology to construct a master program, student agency, teaching agent, information agent network of collaborative learning model of intelligent agents[1].

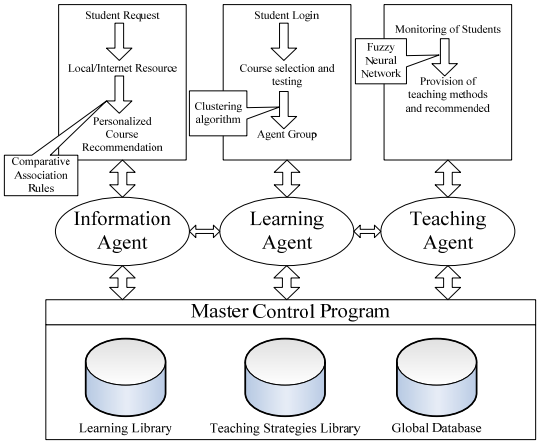

Figure 2. Intelligent agent network model of collaborative learning

III. THE REALIZATION OF PERSONALIZED LEARNING IN SYSTEM

A. Design method base on ACO clustering (Ant colony algorithm)

In the network collaboration model, the basis for dynamic collaborative groups can be divided into: course name, course concepts, reception, thinking in several aspects, different learners have different attributes for different weights allocated in proportion. Therefore, we can ACO approach, according to different learners with different attributes for clustering. Clustering algorithm based on ACO[2], the basic idea is to cluster the learners to be placed in a random n-dimensional space, n the decision by the pre-set attributes, each learner has a random initial position, and The n-dimensional space can move at random and measure the current object similarity in the local environment group, the probability of conversion functions to groups by similarity into the probability of moving objects in order to determine the probability of pick up or drop the object, so that is the same class of objects in the same region of space can be accumulated together.

The network collaborative learning model, student agents use intelligent clustering algorithm based on Ant, according to the learners in your choice of course name, course concept, the learner's ability of receive, thinking users, to clustering, access to a variety of collaborative learning agent groups, so as to fully mobilize the enthusiasm of collaborative learning team members. Concrete implementations are as follows: based on Ant Colony algorithms, take the concept of curriculum name, curriculum, learner's ability of receive, thinking four attributes, each level of a property with multiple values.

Acquisition criteria are given in table I. (The case of a computer teaching)

TABLE I. LEARNERS SCORING TABLE

Attribute		Attribute rating	Attribute weights
Course	Graphics Technology	1	4
	Computer Network	2	
	Database Applications	3	
	Object-oriented programming	4	
	Computer Organization	5	
	Introduction to Multimedia	6	
	Artificial Intelligence	7	
	Data Structure	8	
	Distributed Systems	9	
	Network Programming	10	
	Software Engineering	11	
	E-Commerce	12	
	Management Information System	13	
	Programming Fundamentals	14	
	Network Security	15	
Course Concept	Network	1	4
	Hardware	2	
	Software	3	
	Database	4	
	Method	5	
	System	6	
	Management	7	
Receiving Capability	Poor	1	3
	Medium	2	
	good	3	
Thinking Bias	Thinking in terms	1	3
	Logical thinking	2	
	Innovative Thinking	3	

Attribute score and the value of attribute weights have been normalized in table, the minimum is 0 and the maximum is 15. In this case, the level of each attribute combination will be used as an ant, that is, the 4-dimensional space has 150*15*7*3*3 groups of ants doing group activities. Standardized value of the attribute weights range is 15, so selected group similarity coefficient between in 15 and 16. Parameters of experiment are as follows:

Group similarity coefficient a =15~16; the 4-dimensional space; the number of the ants is150*15*7*3*3; r=0.5;α=1;β=1; p_0 =0.75; ε =0.1;(r: cluster radius; ε :statistical error; α,β: control parameters)

1) Algorithm Description:

a) Initialization:set

$$m, n, r, \varepsilon_0, \alpha, \beta, \tau_{i,j}(0) = 0, p_0$$

b) Between X_i and X_j Euclidean distance is:

$$d_{ij} = \left\| p(X_i - X_j) \right\|^2 = \sqrt{\sum_{k=1}^{n} p_k (x_{ik} - x_{jk})^2}$$

Calculate the path information content is:

$$\tau_{ij} = \begin{cases} 0 & d_{ij} \le r \\ 1 & d_{ij} \ge r \end{cases}$$

Calculate Composite similarity is:

$$f(x_i) = \sum_{x_i \in Nei(r)} \left[1 - \frac{d(x_i - x_j)}{a} \right]$$

c) the probability of X_i is integrated into the neighborhood of X_j is:

$$p_{ij}(t) = \frac{\tau_{ij}^{\alpha}(t) f_t^{\beta}(x_i)}{\sum_{s \cup S} \tau_{sj}^{\alpha}(t) f_t^{\beta}(x_s)}$$

d) Determine $p_{ij}(t) \le p_0$ whether to established

e) According $\overline{C} = \frac{1}{J} \sum_{k=1}^{J} x_k$ to calculate type of cluster center

f) According $D_j = \sum_{k=1}^{j} \sqrt{\sum_{i=1}^{n} (x_{ki} - c_{ji})^2}$ *calculate the deviation error of section i cluster*

g) Calculate the total error by $\varepsilon = \sum_{J=1}^{K} D_J$

h) Determine $\varepsilon \le \varepsilon_0$ *whether to establish, If established to stop，and Output k which is number of clusters and* $\overline{C}_j$ *which is number of cluster centers; If not established, then go to b) continue iterations until the output of final results*

2) Conclusion:

In this model, a time login of learners attribute rating, by the ant colony clustering algorithm. Known by the attribute weights, course name, course concepts, are two key attributes, therefore, the final result will be projected onto two-dimensional flat of the course name, course the concept of horizontal and vertical coordinates, the results shown in Figure 3

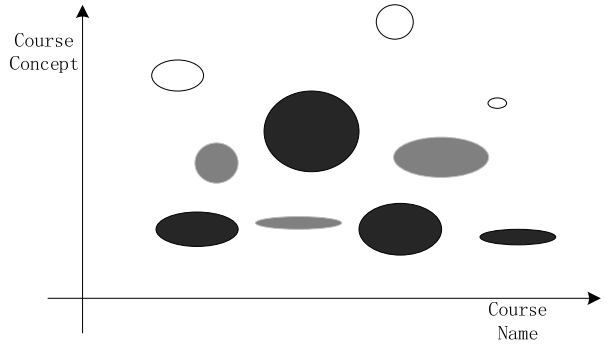

Figure 3. Result

Figure shows the clustering results, a time log of the 50 learners attribute rating. 50 learners in the sample data, using ant colony intelligence clustering method, three categories of the experiment, a total of 10 small group class collaborative learning agents, that the courses were selected based on learner , course concepts, learners are received, thinking bias, the 50 learners were divided into groups of ten collaborative learning agents. The black cluster of courses that were selected based on the learner, the curriculum concepts and the ability to receive learner group, the largest black middle cluster shows some of the better reception of the students in learning " E-commerce" course approach section. Gray said that in the course name, course concepts and thinking in the learner's preferred mode of the three properties, light gray in the four properties on the common preference model. In addition, there are some scattered around the isolated point, expressed some of these isolated points more personalized needs of learners in this to not be considered.

B. The teaching methods based on fuzzy neural network

A good teaching method is important factor to improve teaching effectiveness. In the process of teaching practice, teaching methods varied, each method is different selection criteria. When choices teaching methods. Student has some facts of lubricity and instability. How to different students, quickly and efficiently select a personalized teaching method? Many ways to choose teaching methods can be summarized as algorithm-based approach, rule-based approach, and model-based approach. Algorithm-based approach is constituted by the logic and algorithms, for example: pattern recognition, fuzzy mathematics, artificial neural networks. It is suitable for fast real-time applications, and the need to complete mathematical calculations on a more accurate value of the task, the computer can give full play to the advantages of fast computation, but the knowledge and reasoning are mixed in the program, knowledge is implicit, is not conducive to knowledge expansion and modification. The fuzzy technology of logical reasoning skills and higher order information processing technology combine with neural network; can greatly expand the ability of neural networks to process information. Not only deal with precise information, it can handle fuzzy information; not only to achieve precise association and mapping, but also to achieve inaccurate association and mapping, in particular, fuzzy associative and fuzzy mapping.

1) Fuzzy neural network

Rule k: If x_1 as A_{k1}, x_2 as A_{k2},...x_N as A_{kn}, so y_1 as B_{k1},y_2 as B_{k2},… y_m as B_{km}, A_{ki} and B_{kj} is fuzzy sets in u_i and v_j, and $X=\{x_1,x_2,\ldots x_n\}T \in U_I \times U_2 \times \ldots \times U_n$, $Y=\{y_l,y_2,\ldots y_m\}T \in V_1 \times V_2 \times \ldots \times V_m$, It is the input and output of the fuzzy logic system, Assumptions: have K fuzzy IF THEN rule items. The fuzzy logic system, which made up of center average fuzzifier, product inference rule and fuzzy generator, produce numeric output has the form:

$$y_j = \frac{\sum_{k=1}^{K} b_{kj} (\prod_{i=1}^{n} \mu_{A_{ki}}(x_i))}{\sum_{k=1}^{K} \prod_{i=1}^{n} \mu_{A_{ki}}(x_i)}$$

$\mu_{A_{KI}}$: the membership function of fuzzy set A_{ki}.

2) Fuzzy neural network structure

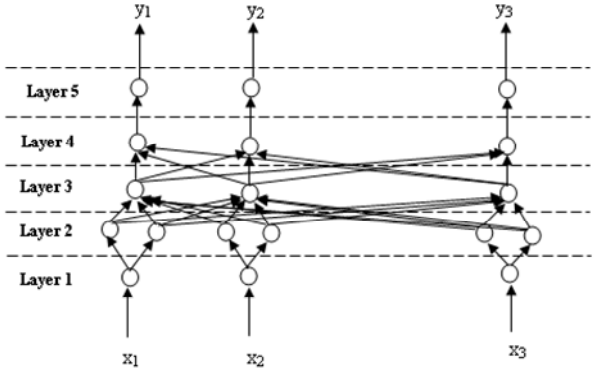

Figure 4. The fuzzy neural network structure

Layer 1: Input layer, Input vector of this layer can be accurate numerical vector, and can be blur.

Layer 2: Fuzzy layer, the layer uses Gaussian function as membership function, x_i and the node i output is:

$$\mu_{A_{ij}}(x_i) = \exp(-(\frac{x_i - m_{ij}}{\sigma_{ij}})^2)$$

m_{ij} :mean of A, σ_{ij} :variance of A, let $N = \sum_{i=1}^{n} n_j$, J=1,2,…N, N nodes in the layer.

Layer 3: Fuzzy inference layer, normalized operations for the output of layer 2.

$$\mu'_{A_{ij}}(x_i) = \frac{\mu_{A_{ij}}(x_i)}{\sum_{i=1}^{n} \mu_{A_{ij}}(x_i)}$$

put front node and output nodes connected. Therefore, the initialize network structures of fuzzy neural network have $K = \prod_i n_i$ irregular nodes. The node *k* output of the node:

$$z_k = \prod_{i=1}^{n} \mu'_{A_{is_i}}(x_i),\ s = s(k,i),\ n_i \geq s \geq 1$$

According to the following equation:

$$s(k,i) = (k + \sum_{j=1}^{n} n_i^j - \sum_{j=1}^{i=1} s(k,j) n_i^{j-1}) / n_i^{j-1} / n_i^{j-1} \bmod n_i$$

if $s(k,i) = 0$, then $s(k,i) = n_i$

Layer 4: Anti-fuzzy layers, all the rule node of layer 4 connect to output node. This layer completed an average of anti-blur operation. Layer 4 has P nodes, the first i-output component:

$$y_i = \sum_{k=1}^{k} b_{jk} z_k = \sum_{k=1}^{k} b_{jk} z_k \prod_{i=1}^{n} \mu'_{A_{sii}}(x_i)$$

Layer 5: Output layers, output the output node.

3) Based on fuzzy neural network learning algorithm

Use gradient descent method to adjust the parameters of fuzzy neural network learning algorithm. Minimizing the error function: $E = \frac{1}{2} \sum_{i=1}^{M} \left\| D_i - Y_i \right\|^2$, *Y*: output of fuzzy neural network learning algorithm, *D* is the first i samples of the desired output. If w_{ij} is the parameter to be adjusted, the rules:

$$w_{ij}(t+1) = w_{ij}(t)\eta - \frac{\partial E}{\partial w_{ij}} + \alpha \Delta w_{ij}(t)$$

$$\Delta w_{ij}(t) = w_{ij}(t) - w_{ij}(t-1) \quad (1)$$

η : learning rate, α : inertia coefficient. Order w = b, m and S, be:

$$\frac{\partial E}{\partial b_{kj}} = (y_j - d_j) z_k \quad (2)$$

$$\frac{\partial E}{\partial m_{ij}} = \sum_{j=1}^{p} (y_j - d_j) \sum_{k=1}^{k} b_{kj} (\frac{\delta(j, s(k,i))}{X} - \frac{Y}{X^2}) \frac{\partial \mu_{A_{ij}}(x_i)}{\partial m_{ij}} \quad (3)$$

$$\frac{\partial E}{\delta_{ij}} = \sum_{j=1}^{p} (y_j - d_j) \sum_{k=1}^{k} b_{kj} (\frac{\delta(j, s(k,i))}{X} - \frac{Y}{X^2}) \frac{\partial \mu_{A_{ij}}(x^i)}{\partial \delta_{ij}} \quad (4)$$

In this equation, $X = \sum_{j=1}^{n} \mu_{A_{ij}}(x_i)$, $Y = \mu_{A_{i,s(k,j)}}(x_i)$

$$\frac{\mu_{A_{ij}}(x_i)}{m_{ij}} = \frac{2(x_i - m_{ij})}{\delta_{ij}^2} \mu_{A_{ij}}(x_i)$$

$$\frac{\mu_{A_{ij}}(x_i)}{m_{ij}} = \frac{2(x_i - m_{ij})^2}{\delta_{ij}^3} \mu_{A_{ij}}(x_i)$$

In the equation $\delta(j, s(k,j)) = \begin{Bmatrix} 1 & j = s(k,i) \\ 0 & j \neq s(k,i) \end{Bmatrix}$, put (2) - (4) into (1), obtain the parameters update rule of fuzzy neural network

4) Fuzzy neural network learning model parameter settings

Because the selection of teaching strategies and teaching objectives, teaching content and personal learning ability of students and many other factors related. Therefore, the selection of parameters not only reflects the learning ability of individual students but also reflect the general teaching of law. I selected the following forms of expertise fuzzy rules:

Rule 1: IF *student learning multimedia systems design software* AND *strong received ability* AND *strong thinking ability* THEN *by coach method.*

Rule 2: IF *student learning the structure of the computer hardware* AND *receiving weak* AND *strong logical thinking ability* THEN *by law method*.

Rule 3: IF *the students design software part of the learning process* AND *general receiving abilities* AND *strong creative thinking ability* THEN *by task-driven method*.

Rules can be used to describe the following manner: (course content, student acceptance, student thinking bias, the selected teaching method), the number of rules to determine the number of nodes K in teaching reasoning layer.

Student basic library provides student received ability and student thinking bias. Focus on the receive capability of students, the each state of students thinking are used represented in the fuzzy membership functions. For example: the accept ability of students in the state of the teaching characteristics can be divided into "good", "medium", "poor" three levels, all belong to fuzzy

concept, it is desirable the domain M=[0,100], good, medium, poor may represent the three fuzzy sets on M, and their membership functions, as:

$$\mu_{good}(X)=\begin{cases}1 & 100\geq X\geq 80\\ e^{\frac{1}{100}(X-80)^2} & 80\geq X\geq 0\end{cases}$$

$$\mu_{medium}(X)=e^{\frac{1}{100}(X-60)^2},100\geq X\geq 0$$

$$\mu_{poor}(X)=\begin{cases}1 & 30\geq X\geq 0\\ e^{\frac{1}{100}(X-30)^2} & 100\geq X\geq 30\end{cases}$$

Similarly, uses the same fuzzy methods deal with students thinking bias. We use the vector X=(x_1, x_2, x_3, x_4, y) that one of the training samples. x_1: a certain teaching characteristics. x_1: the selected course number of students $(1\leq x_1\leq 15)$. x_2: courses concepts that students selected course $(1\leq x_2\leq 7)$. x_3: the value of acceptability of students $(0\leq x_3\leq 100)$. x_4: thinking ability value $(0\leq x_4\leq 100)$.y: number that realized choose teaching methods, the output value y '. Use B-P algorithm:

a) Let t = 0, randomly generated on the float m^{ij} *, and set w;*

b) Count=1, t+1

c) Computing first Count sample output of the current, if the error of output and expected output that meet the requirements, then Count=Count+1,goto c)

d) According to self-learning algorithm to adjust the weights m^{ij} *, goto c)*

e) Calculate the average variance of all samples, if the average variance to meet the requirements, algorithm stops, goto b)

The test results in Appendix

C. Personalized course recommendation

1) Aproil mining algorithm for association rules

Association rules mining is found the relationship in vast amounts of data items, is hot topic in the field of data mining. Mining association rules can be divided into two sub-problems: find frequent item sets and association rules generate. In 1993, Agrawal designed a basic algorithm for mining association rules is proposed as an important method, which is the classic Apriori algorithm. The concept of Apriori algorithm:

- $I = \{i_1, i_2, \ldots, i_m\}$: a set of items.
- $J = P(I)$ set of all subsets of the set of items, elements of J are called item sets
- Transaction t: t is a set of items, and t $\subseteq$ I.
- Transaction Database T: a set of transactions $T = \{t_1, t_2, \ldots, t_n\}$.
- An association rule is an implication of the form : $X->Y$, where X, Y are disjoint subsets of I (elements of J)
- Support: is defined as *support(X) = occur(X) / count(T) = P(X).*
- Confidence: is defined as *confidence(X->Y) = support* $(X \cup Y)$ */ support (X) = P (Y|X).*

The problem is find association rules that have support and confidence greater that user-specified minimum support and minimum confidence.

The basic idea of Apriori algorithm:

- Uses a Level-wise search, where k-itemsets(An item sets that contains k items is a k-itemsets) are used to explore (k+1)-item sets, to mine frequent item sets from transactional database for Boolean.
- First, the set of frequent 1-itemsets is found. This set is denoted L1. L1 is used to find L2, the set of frequent 2-itemsets, which is used to fine L3, and so on, until no more frequent k-itemsets can be found.

Association rule mining process:

- Find all frequent item sets: Each support S of these frequent item sets will at least equal to a pre-determined minimum support (An item sets is a subset of items in I, like A).
- Generate strong association rules from the frequent item sets: These rules must be the frequent item sets and must satisfy minimum support and minimum confidence.

Pass 1

a) Generate the candidate itemsets in C_1

b) Save the frequent itemsets in L_1

Pass k

c) Generate the candidate itemsets in C_k *from the frequent itemsets in* L_{k-1}

Join L_{k-1} *p with* L_{k-1}*q, as follows:*

Insert into C_k

Select $p.item_1, p.item_2, \ldots, p.item_{k-1}, q.item_{k-1}$

From $L_{k-1}p, L_{k-1}q$

Where $p.item_1 = q.item_1, \ldots p.item_{k-2} = q.item_{k-2}, p.item_{k-1} < q.item_{k-1}$

Generate all (k-1)-subsets from the candidate itemsets in C_k

Prune all candidate itemsets from C_k *where some (k-1)-subset of the candidate itemset is not in the frequent itemset* L_{k-1}

d) Scan the transaction database to determine the support for each candidate itemset in C_k

e) Save the frequent itemsets in L_k

2) Course conceptualization

Information agent is responsible for search and filtering the learning resources in the system and the entire Internet network resources. Information retrieve

and filtering agent is responsible for the learning resources in the system and the entire Internet network resources. Learners to their own information needs (course name or course concepts) presented by the student agent to the information agent, information agent can not only automatically by course name from the course of the system resources or network resources get information, and when learners need to search for a course with the concept of the course will be personalized intelligent recommendation.

Classification of the course in order to reduce the size of the course matrix, and then extract the important concepts of course and conceptual operate. For example: software engineering (software, methods, management), operating system (software, methods, systems), "Software Engineering", "operate system" is the course, "the software", "the method", "the management", "the system" is the course concept. Record of the student's course selection, and then apply Apriori algorithms to data mining. Finally, according to the results of data mining obtained the preferences vector of the students. For example, get the selection record of student A, TableII, which projects A, B, C, D, E, F, G represent the course concept "network", "hardware", "Software", "database", "method", "system", "Management".

TABLE II. SELECTION RECORD OF STUDENT A

Course name	Course concept	Project
Network program design	[network, software, method]	[ACE]
Network Security	[network, hardware, principle]	[ABG]
Distributed Systems	[network, system, principle]	[AFG]
Software Engineering	[software, method, principle]	[CEG]
Systems Analysis and Design	[software, database, method, system]	[CDEF]
Multimedia System Design	[software, system]	[CF]
Database Management	[network, database, principle]	[ADG]
E-Commerce	[software, database, method, system, principle]	[CDEFG]
Programming Fundamentals	[software, system]	[CF]

Data mining base on Apriori algorithm used in the above table, and finally obtained the v-table TABLE III which scaled the concept of course for students with preferences.

TABLE III. THE PREFERENCES V-TABLE OF STUDENT A

Preference vector	confidence
A->G	0.82
C->E	0.75
C->F	0.82

3) Course Recommendation

When students in the personalized Web learning system, you want to search with a course of course concept, according to vector preferences of course concepts converts vector preference rules, and comparison with the course vector feature comparison formulas, and characteristics on the ratio of the size of the V value, for course recommend. For example: A student want to search with the course of C (software) the concept courses: According vector preferences of course concepts of student A ,C-> E, C -F ,A can be derived may be preference a "software", "Method", "system"(C, E, F) the course of the course concept, the vector preference of course into the concept of preference rules of " 0010110 "(Course may be preference to the concept of value set to 1, the rest set to 0), Course vector and preference rules vector comparison using the formula comparing characteristics of the ratio of V values are the more they meet the requirements.

IV. CONCLUSION

The research introduces intelligent agent technology in the field of distributed artificial intelligence, to construct intelligent agent model for collaborative learning network which composite with a control program, students agent, teaching agent, information agent. according to the learners in your choice of course name, course concept, the learner's ability of receive, thinking users, to clustering, access to a variety of collaborative learning agent groups, so as to fully mobilize the enthusiasm of collaborative learning team members.

APPENDIX A TEST SAMPLES

X_1: Course No, X_2: Course Concept, X_3: Reception, X_4: Thinking Bias, X_5: Teaching Methods

X_1	X_2	X_3	X_4	X_5
1	5	100	86	4
4	6	90	100	1
7	1	65	75	3
8	3	62	99	2
9	3	96	75	6
3	2	60	64	6
5	7	98	70	5
2	4	74	60	4

APPENDIX B MODEL PREDICTION COMPARED WITH MEASURED VALUES

X_1: Course No, X_2: Course Concept, X_3: Reception, X_4: Thinking Bias, Y: Teaching Methods, Y': Output value

X_1	X_2	X_3	X_4	Y	Y'
1	5	100	86	4	4.25
4	6	90	100	1	12.88
7	1	65	75	3	14.46
8	3	62	99	2	3.56
9	3	96	75	6	15.789
3	2	60	64	6	5.027
5	7	98	70	5	14.239
2	4	74	60	4	7.142

APPENDIX C TEAEHING METHODS

Teaching Methods No	Teaching Methods Name
1	Coaching Methods
2	Case method
3	Demonstration method
4	Practices
5	Kind of teaching method
6	Interactive teaching method

APPENDIX D COURSE - CONCEPT

Course no	Course name	Course concept
1	Network program design	[network, software, method]
2	Network Security	[network, hardware, principle]
3	Distributed Systems	[network, system, principle]
4	Software Engineering	[software, method, principle]
5	Systems Analysis and Design	[software, database, method, system]
6	Multimedia System Design	[software, system]
7	Database Management	[network, database, principle]
8	E-Commerce	[software, database, method, system, principle]
9	Programming Fundamentals	[software, system]

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