Intelligent Curriculum Arrangement Subsystem of Educational Administration Oriented Stratified Teaching Model Design

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Abstract. Stratified teaching model is a new teaching model that widely used for various universities, this paper is given curriculum arrangement system design combined with genetic algorithm for the stratified teaching model. This paper, firstly, analyzes the demands and introduced constraints to intelligent curriculum system oriented stratified teaching model; secondly, describe the overall design framework based on the demands of intelligent curriculum system oriented stratified teaching model; finally, established the mathematical model and related algorithm is presented for intelligent curriculum arrangement system oriented stratified teaching model.

Keywords: Stratified teaching mode; curriculum arrangement system design; genetic algorithm.

1. Introduction

In foreign countries, as early as 1963, Gotlieb proposed the mathematical model of course arrangement; in 1976, even proves that the problem is a class of combination optimization problem, belongs to the NP problems. [1]Foreigners provided the main approaches to the study of the problem, a graph theory method, simulated annealing method, the Lagrange relaxation method, genetic algorithm, etc [2].

In my country, in 1984, Lin Zhangxi and Lin Yaorui published the achievement of experimental research of the course arrangement system. At present, there are a lot of achievement for the course arrangement system, and course arrangement subsystem of these systems can help teaching staff in course arrangement work efficiency greatly. [1]At present domestic course arrangement algorithm according to the strategy roughly divided into three categories: arrangement system based on greedy algorithm; course arrangement system based on backtracking algorithm; Arrangement system based on genetic algorithm [2].

These arrangement system is geared to the needs of the traditional teaching model to develop and use, does not apply to the stratified teaching model.We have carried on the survey and analysis to the stratified teaching model, summed up the stratified teaching model of scheduling rules and constraints.Genetic algorithm will be applied to the curriculum arrangement system oriented the stratified teaching model. Genetic algorithm has a strong ability to work in parallel, improves the efficiency of the system, with the method of kruscal algorithm and hybrid genetic algorithm, could help arranging elements encoding and decoding and test the effectiveness of the individual.

2. The demand analysis

Many universities to the students of different levels and base implement the stratified teaching model, adopting stratified lessons, teaching and practice, to maximum students' learning enthusiasm and initiative.After the students stratification, in view of the students of different levels need to arrange courses of appropriate levels.The characteristics of the stratified teaching model is course and class which are divided into multiple layers, but a class are divided into different sub-classes for the different course.At present,students are divided into three layers(A, B, C), therefore course is also divided into three layers(A, B, C).With illustrations to analyze the stratified teaching model,sub course A1 express A level course of course 1,sub class A1 express A level class for course 1(Figure 1).

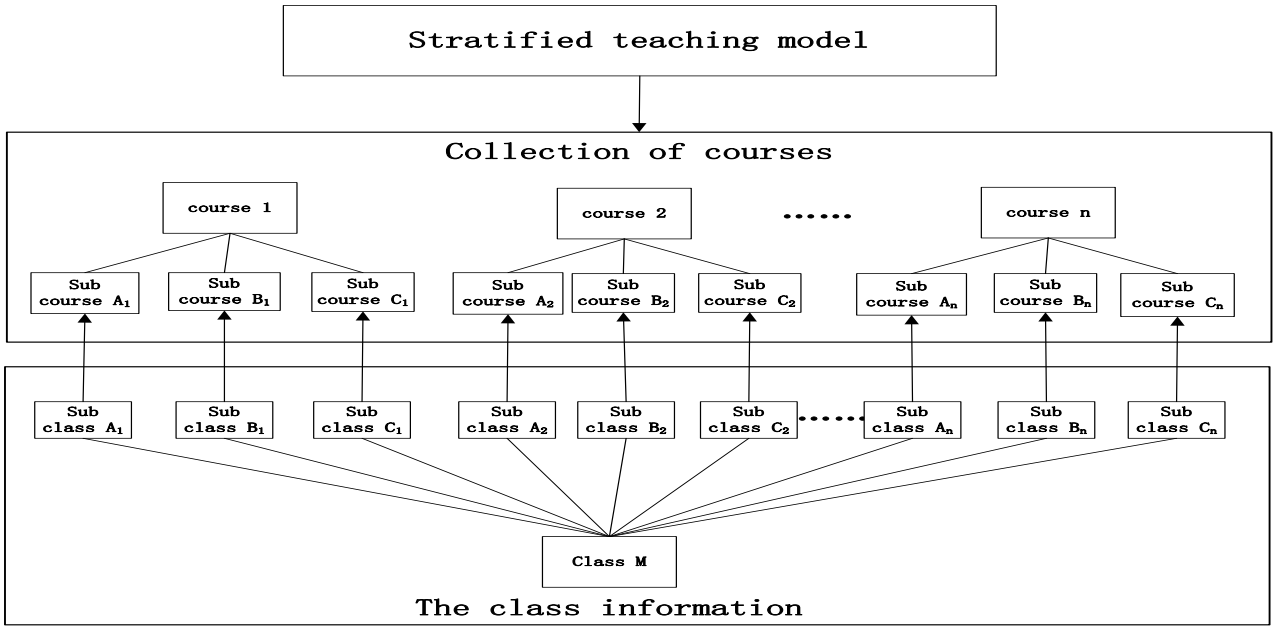

Figure 1 Stratified teaching model

According to the actual situation that intelligent curriculum arrangement system oriented stratified teaching model, summarize the constraint conditions.Rigid constraint is system must be met, including constraints of teachers, classrooms, classes, courses [3];

Constraints of Teachers: a teacher can't be arranged to two classes at the same time;

Constraints of classrooms: a classroom can't be use for two classes at the same time; the number of the students is not greater than the number of classroom seats; the classroom must conform to the requirements of the course;

Constraints of classes: a class can’t be arrange to two different courses at the same time;

Constraints of courses: the level of the course must be consistent with the level of the student.

Flexible constraint is defined with three aspects that expectations of the teaching time, degree of course discrete and time distribution density of the class, the situation of flexible constraint satisfaction become an important indicator for humanization, rationalization and intelligence.

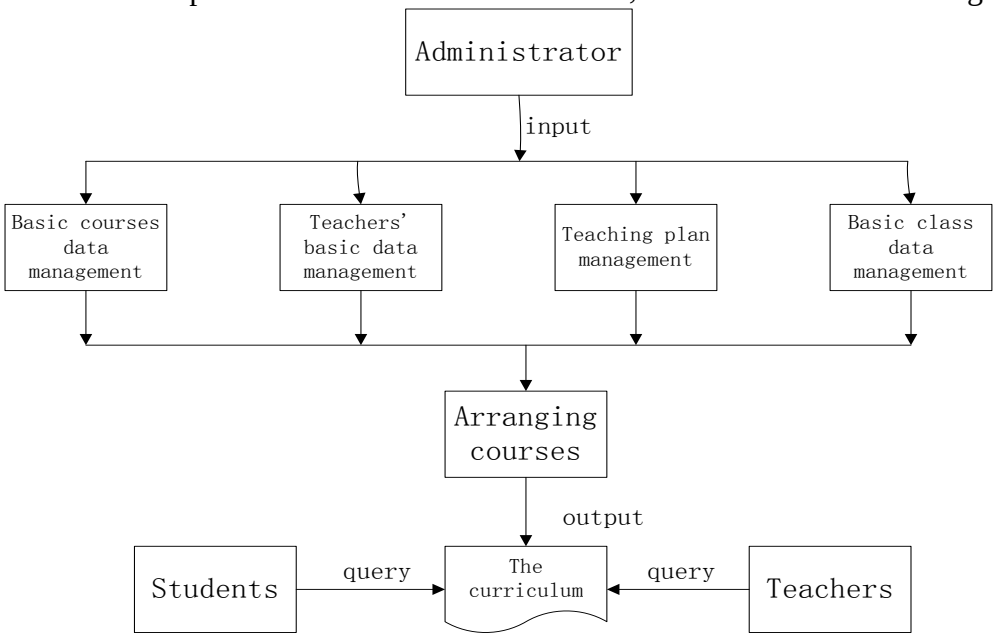

Figure 2 diagram of the whole business process of the course arranging system

3. System Design

Determine the courses arranging management process plays an important role in software development in the late, summed up the whole business process of the course arranging system. As shown in figure 2:

The design of the function structure of the system is core to the overall design of the system.The whole system is divided into several sub modules to independently solve the problem, and then organize all sub modules, as a whole needed to finish the whole system function [4].Between each module in accordance with high cohesion and low coupling.The diagram of the function structure of the system is as shown in figure 3:

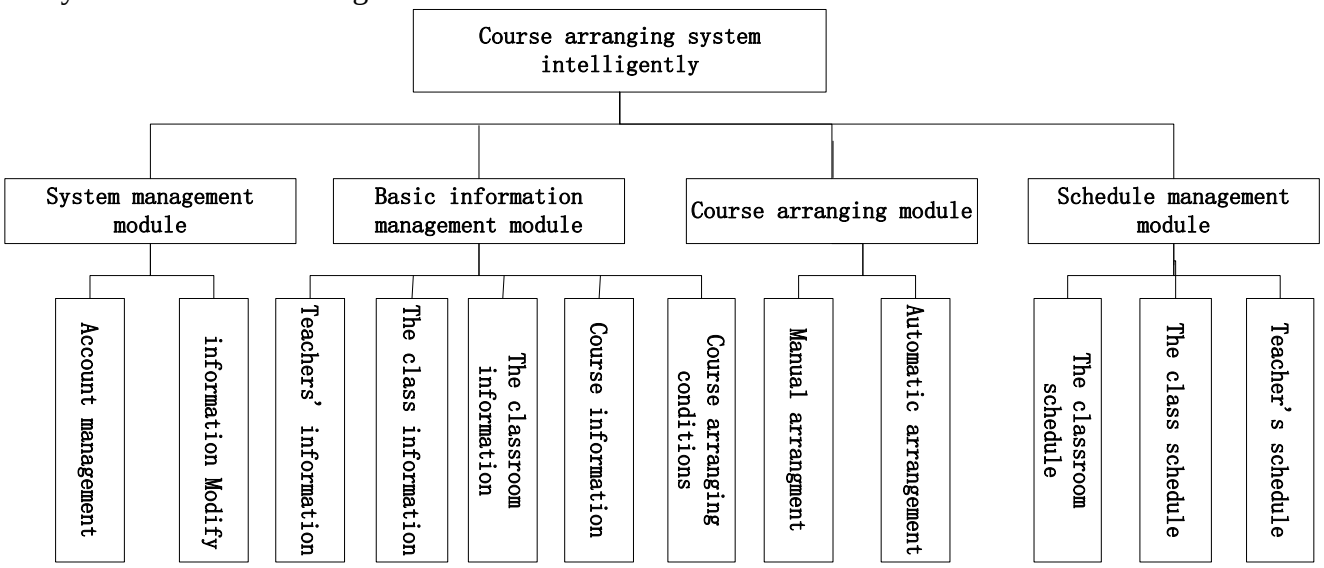

Figure 3 diagram of the function structure of the system

The system is divided into four modules: system management module, basic information management module, course arranging module, schedule management module, each module contains some sub modules.

According to the actual needs of course arranging system oriented stratified teaching, five entities involved in this system: teachers, courses, classes, classrooms, time. Entity relationship attribute figure is as shown in figure 4:

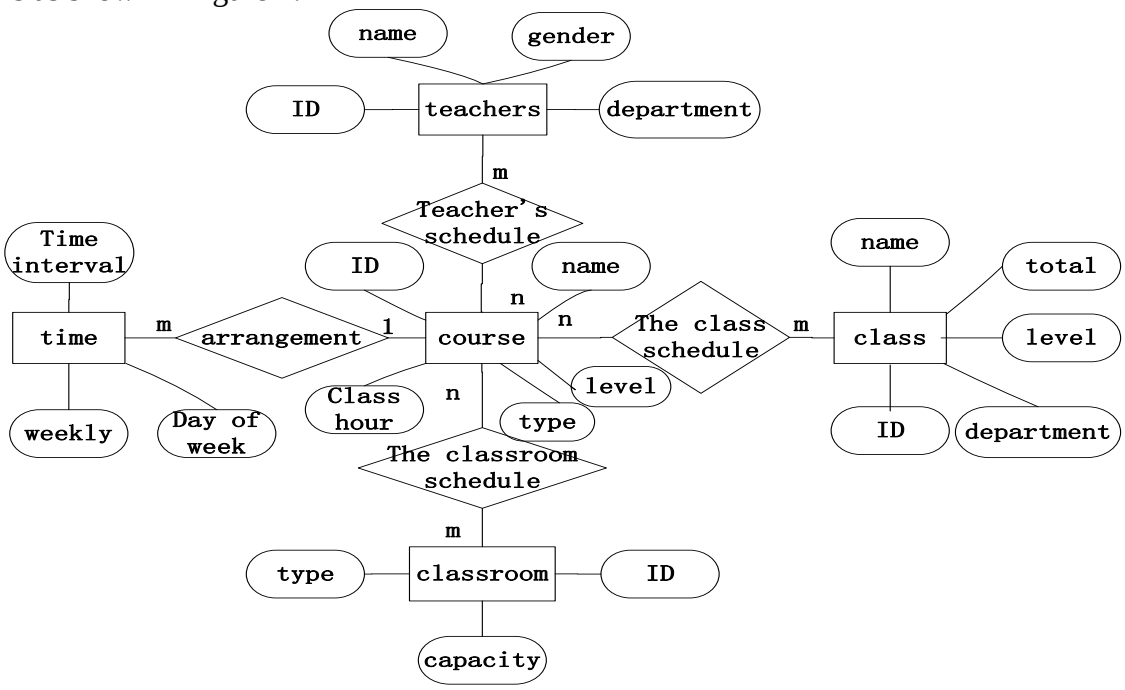

Figure 4 Entity relationship attribute figure

4. Algorithm design of stratified teaching model

4.1 Mathematical description of element for course arrangement

Course set: $C=\{C_1,C_2,...,C_n\}, C_1=\{c_{1A},c_{1B},c_{1C}\}$ ... $C_n=\{c_{nA},c_{nB},c_{nC}\}$, C_i expresses the ith courses, c_{iA} expresses A stratified sub course of the ith course, c_{iB} expresses B stratified sub course of the ith course, c_{iC} expresses C stratified sub course of the ith course.

Teacher set: $P=\{p_1,p_2,...,p_n\}$, p_i expresses the ith teacher.

Class set: $S=\{S_1,S_2,...,S_n\}$, $S_1=\{s_{1A},s_{1B},s_{1C}\}$... $S_n=\{s_{nA},s_{nB},s_{nC}\}$, in the model, class insteads of teaching classes, the teaching class refers to the class that has the same course in the same time in the same classroom. The elements of the class set is a one-to-one relationship with the elements course set. S_i expresses the teaching class that has ith course, s_{iA} corresponding to c_{iA}, s_{iB} corresponding to c_{iB}, s_{iC} corresponding to c_{iC}.

Classroom set: $R=\{r_1,r_2,...,r_n\}, r_i$ expresses the ith classroom.

Time set: $T=\{t_1,t_2,...,t_n\}$, $n\le 5$, t_i expresses the ith time interval, to describe time with day of week, weekly, time interval. There are four lessons in the morning, four lessons in the afternoon, and two lessons in the evening. Every two lessons is a time interval, 1, 2lesson in the morning is the first time, and two lessons in the evening is the fifth time interval.

Solution set: $D=\{c,p,s,r,t\}$, $c\in C$, $p\in P$, $s\in S$, $r\in R$, $t\in T$, solution set is composed of the different combination that course, teacher, class, classroom, time[5].

4.2 Algorithm design

4.2.1 Encoding and decoding

The relationship of the elements that teacher, class, classroom, time, course is expressed with weighted graph, teacher, classroom, time, course, class are vertexes, the weight are their degree of the relationship [1].

a1: the importance of the course to the class;

a2: the effect that courses are arranged in which time;

a3: course requirement for the classroom;

a4: the classroom whether can accommodate the number of the class;

a5: teachers can serve as the course;

a6: teachers' preferences of time.

According to actual circumstances, give each side fixed values, use kruskal algorithm, and can get a minimum spanning tree.According to the corresponding vertex values, the minimum spanning tree code with symbol encoding method. When coding, to all levels of a class as a class. This system adopts the corresponding method directly with sub class and sub course. When decoding, the sub class information and course information corresponds directly, reduce the computational complexity (Figure 5).

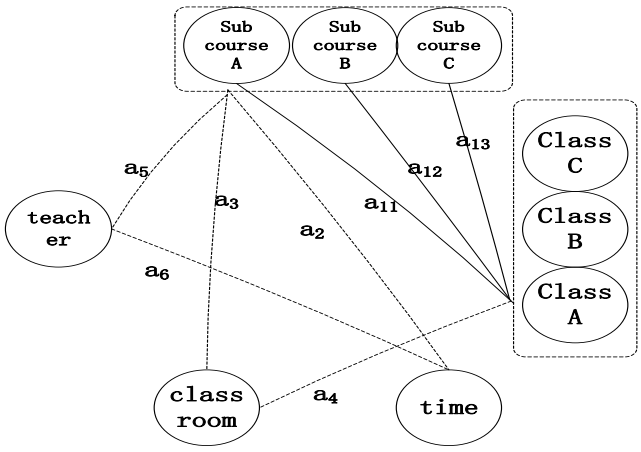

Figure 5 weighted graph

4.2.2 Fitness function

Calculate the result of the fitness function can meet rigid conditions and certain flexible conditions.

To meet the fitness function of the rigid constraint:

$$\boldsymbol{f}_1(\boldsymbol{T}) = \begin{cases} \sum_{i=2}^{n} \boldsymbol{w}_i \boldsymbol{Z}_i + (\alpha \boldsymbol{w}_{11} + \beta \boldsymbol{w}_{12} + \lambda \boldsymbol{w}_{13}) \times \boldsymbol{Z}_1 \\ 0 \end{cases}, Z_i = \begin{cases} 1 & e_i \in T \\ 0 & e_i \in T \end{cases}, \alpha, \beta, \lambda \in (0,1),$$

T is the minimum spanning tree of the graph, w_i is the edge weights. As invalid individuals, Make the individual fitness value is 0.The value of f_1 is the greater, then the effect is the better.

Class Time expectation function [1].Class time expectations reflect the degree of students or teachers in a certain time period class like or a class of high and low efficiency,

$f_2 = \sum_{i=1}^{n} q_i$, q_i express the class time of expectations, n is the total number of courses. The value of f_2 is the greater, then the effect is the better.

Course discrete degree of class: A course cannot repeat classes during the day, the 5 days a week to arrange. The combined number that three times a week of the course is $C_5^3 = 10$, the combined number that six times a week of the course is $\boldsymbol{C}_5^1 = 5$, the combined number that nine times a week of the course is $\boldsymbol{C}_5^4 = 5$. We use the average of all discrete degree of the courses as measured standard.

$\boldsymbol{f}_3 = \frac{1}{\boldsymbol{n}} \left(\sum_{i=1}^{e} \sum_{a=1}^{10} \boldsymbol{x}_{ai} + \sum_{j=1}^{f} \sum_{b=1}^{5} \boldsymbol{y}_{bj} + \sum_{k=1}^{g} \sum_{c=1}^{5} \boldsymbol{z}_{ck} \right)$, x_{ai} expresses discrete degree that Courses of three times a week are arranged on scheme of a kind; $\boldsymbol{y}_{bj}$ expresses discrete degree that courses of six times a week are arranged on scheme of b kind; z_{ck} expresses discrete degree that courses of nine times a week are arranged on scheme of c kind; $n = e + f + g$, e expresses the number of courses of three times a week; f expresses the number of courses of six times a week; g expresses the number of courses of nine times a week. The value of f_3 is the greater, then Course discrete degree of class is the higher.

Class distribution density: $\boldsymbol{f}_4 = \frac{\sum_{i=1}^{N} \sum_{j=1}^{d} \left| \boldsymbol{m}_{ij}^{\ 2} - \left(\frac{1}{\boldsymbol{d}} \sum_{j=1}^{d} \boldsymbol{m}_{ij} \right)^2 \right|}{\boldsymbol{Nd}}$, m_{ij} d expresses working days a week, generally for 5 days; N expresses the total of the class. The value of f_4 is the smaller, then Class distribution density is the average.

To sum up: the fitness function is $F = k_1 f_1 + k_2 f_2 + k_3 f_3 - k_4 f_4$, $k_i (i = 1,2,3,4) \in (0,1)$, the value of k_i based on the actual demand to sure, Making arrangement of courses more humanized and more rationality.

4.2.3 The genetic operation

There are three main kinds of genetic operations: selection, crossover and mutation.

Selection: Using the choice strategy of random traverse sampling, Assume that S for the number of individuals need to choose, Choose individual equidistantly, distance of the choice pointer is $\frac{2}{S}$.

Crossover: L1 and L2 that two individuals be selected out as parents, part of the two values exchanged. Suppose you have five long two individuals as follows:

L1	c_{1A}	p_1	S_1	r_2	t_3
L2	c_{2C}	p_2	S_2	r_1	t_2

Generate a random number between 1 and 5,if the produce is 3 now,low three of L1 and L2 to exchange,high two of L1 and low three of L2 form string $c_{1A}\ p_1\ S_2\ r_1\ t_2$,this is one offspring individual of L1 and L2;high two of L2 and low three of L1 form string $c_{2C}\ p_2\ S_1\ r_2\ t_3$,this is another offspring individual.

Mutation: Change the string character on one of the position.Randomly generated a number between 1 ~ 5, if the produce is 2, replace 2nd with other elements of that set.

The end of the term: Define a generations as a condition of the end of the algorithm, when genetic algorithm iteration to this generation, algorithm is terminated, and the current solution as the final solution.

5. Conclusion

In the first of this paper, this paper analyzes the research status about course arranging system at home and abroad, and elaborates the feasibility of curriculum arrangement oriented stratified teaching according to popular stratified teaching method. After, detailed analysis the demand of stratified teaching curriculum arrangement, and gives two kinds of soft and hard constraints. Then, it gives each module of the stratified teaching arrangement system. Finally, established model of curriculum arrangement oriented stratified teaching, and given algorithm combined with genetic algorithm and kruscal algorithm under the model.

References

[1]. Yong Peng. Research on the Application of Genetic Algorithm in Educational Management system [D].2013.

[2]. Shi Wen. A Master Thesis Submitted to University of Electronic Science and Technology of China [D].University of electronic science and technology of China.2013.

[3]. Zhao Yao-feng. Intelligence Course Scheduling System Based on Hybrid Algorithm [J].Modern Electronics Technique.2011.

[4]. Xing Fang. Arrangement System Designing Based on B/S [J].Science Mosaic.2011.

[5]. Yuji Li, Caiwu Lu, Guan Liu. Application of Ant-colony Genetic Algorithm in Smart Course Schedule System of Colleges [J].Modern Electronics Technique.2010.