Genetic Algorithm to Solve the Problem Arranging Course

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Keywords: Genetic Algorithm, graph theory, Genetic Algorithm

Abstract. With the continuous development of higher education, reasonable distribution of teaching resources has become an urgent problem in time and space. This question is a typical college course arrangement. Arranging Course problem is NP-complete a multiple target multi portfolio.

We use an improved hybrid genetic algorithm to analyze in depth Timetable optimization problem. Genetic algorithm based on a certain probability based on the size of individual fitness of populations survival of the fittest selection, simulated annealing algorithm is able to accept a certain probability of a temporary degradation phenomenon, which has a certain ability to jump out of local optima were a wider range of search. So we simulated annealing algorithm into genetic algorithm, both to ensure the formation of a hybrid algorithm has the speed of evolution to ensure the quality of the essence in order to get the best method of arranging.

1. Introduction

Arranging Course has long been a problem at home and abroad for many years, this type of schedule (TTP) is a typical combinatorial optimization problems and uncertainty scheduling problems, and has been proven to be NP-complete problem, there is no deterministic polynomial complexity Method [1].

Since the College Time is a very complex problem of combinatorial optimization problems, when only a small amount of data that can convert into a model edge coloring graph theory, so we use a genetic algorithm Course Scheduling problem solver. In solving process to take into account many variables, we have the basis of genetic algorithm increases the simulated annealing algorithm to complete the improved hybrid genetic algorithm Course Scheduling problem solver.

2. General Assumptions

1) the same classroom at the same time can arrange a course;
2) within the same time a student can not simultaneously on two courses;
3) the same time a teacher can not be on two courses;
4) Each classroom classroom capacity is greater than the number of students in class the class;
5) the total number of classrooms at all times to meet the curriculum gates;
6) required courses to meet the needs of the room;
7) does not consider the time when classroom scheduling conflicts;
8) as long as the class is not at the same time, same place to accomplish the same task, are seen as different individuals.

3. Improved Hybrid Scheduling Model Based on Genetic Algorithms

3.1 Design of chromosomes

Establish a total weekly teaching hours to the number of rows, the total number of classrooms for the number of columns two-dimensional matrix, each element of the group as a matrix elements, each containing three variables: number of classes (ie commencement object number) , course number, and classroom number. There is no element that indicates the location of the classroom teaching period no teaching arrangements, can be used for student study and so on. In this coding method can satisfy assumption 2).

Tab1. Design of chromosomes

chromosomes	Classroom1	Classroom2	Classroom3
Classtime1	(Cid_1, Sid_1, Tid_1)		(Cid_3, Sid_3, Tid_3)
Classtime2		(Cid_2, Sid_2, Tid_2)	(Cid_4, Sid_4, Tid_4)
Classtime3	(Cid_5, Sid_5, Tid_5)		

3.2 Generation of initial population

A high-quality initial population of the genetic algorithm to obtain an excellent final result guaranteed, but only to ensure that the initial population of each individual is a feasible solution is not enough, but also need to take into account the evolution of the population, with a population between different individuals if too many similarities in the crossover and mutation operation phase will not be able to produce enough individuals with new traits, tends to occur premature convergence algorithm, we can not be effective global search. In order to increase the diversity of individuals, we each produce a single initial feasible solution in both a certain amount of disorder treatment to increase the difference.

Out of order processing consists of two parts:

1) class out of order processing

First, the various classes according to total weekly lesson times from small to large order of arrangement, then the total weekly lesson times the same class into a group within a group of classes randomly re-ordering.

Tab2. Out of order processing of class

before	68	75	76	6	17	32	71	3	18	21
the frequency per week	2			3				4		

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after	75	76	68	32	17	71	6	21	3	18
the frequency per week	2			3				4		

2) subjects out of order processing

For each class to learn all subjects were also randomly re-ordering.

3.3 Design Options

Natural selection is a process of survival of the fittest, so that the entire population evolving, so the use of genetic algorithms but also on the poor performance of the feasible solutions were eliminated. The method we use is roulette bet method, its basic idea is proportional to the size of each individual probability of being selected as their fitness values. For the size of a population to adapt to the degree of the individuals referred to as value, it probability of being selected by the formula (1) is calculated. The formula can not only ensure the calculated value is a number between 0 and 1, but also to ensure proportional to the size of the corresponding.[2]

$$p_i = \frac{f_i}{\sum_{i=1}^{n} f_i} \qquad (1)$$

After selection got a new population, new and original population size population consistent for the next crossover and mutation operations ready.

3.4 crossover design

Select Options Although the overall performance of the temporary population increase, but it resulted in reduced diversity, and therefore need to be a certain degree of genetic information exchange between different parent individuals to generate new traits of individuals.

When on combinatorial optimization problem to solve, it is to make the crossover between different feasible solutions according to certain rules of information exchange, to generate new feasible solution. We have adopted a two-point crossover method to reach a new generation of viable solutions while avoiding too many changes for the purpose of generating a non-viable solution. Meanwhile, in order to ensure the effect of improving the operation of the solution of the cross, we have introduced competition mechanism, both parent and two offspring individuals by their cross generated by the operation compares the fitness values, the highest fitness value the crossover operation as an individual resulting individual.

The following example to explain the specific account number matrix crossover steps:

1) For the operation to cross the two parent individuals - are denoted by a parent on behalf of individuals 1 and 2 parent individuals, find their account number of chromosomes arranged in a matrix have the same time and in the same classroom teaching and the corresponding the account number of different elements, where the location of these elements as a cross-operating position of the candidate.

2) From the candidate position randomly selected a location, assuming that the individual parent 1 and parent 2 individual account number at that location is Sid1 and Sid2, to swap them separately. At this offspring produced more than 1 in a Sid2 one less Sidl, and 2 more offspring a Sidl one less Sid2, obviously, two offspring corresponding matrix is not a viable Scheduling programs, they need to be amended. To find out from the offspring crossover operation before 1 already exists Sid2 (there may be more than one), into a collection 1; identify the offspring from 2 anterior cruciate operation already exists Sid1 (there may be more than one) , into a collection 2. Optionally a Sid2 from the collection 1, optionally from a set of 2 to their positions in the two offspring are interchangeable[3].

Tab3. The Process of crossover

parent 1	room1	room2	room3	parent2	room1	room2	room3
Time1	Sid1			Time1	Sid2		Sid3
Time2			Sid2	Time2		Sid1	
Time3		Sid3		Time3			

ffspring1	Room1	Room2	Room3	offspring2	Room1	Room2	Room3
Time1	Sid2			Time1	Sid1		Sid3
Time2			Sid2	Time2		Sid1	
Time3		Sid3		Time3			

offspring1	Room1	Room2	Room3	offspring2	Room1	Room2	Room3
Time1	Sid2			Time1	Sid1		Sid3
Time2			Sid1	Time2		Sid2	
Time3		Sid3		Time3			

3.5 Design of mutation

Gene mutation in biology refers to the genetic information of certain genetic mutations can occur from parent to offspring transfer process, so that the offspring have some genetic information that does not have a parent. Also has the characteristics of survival of the fittest, evolution can play a catalytic role. The application of gene mutation thought to solving combinatorial optimization problems, it is to structure a viable solution of partial trimming according to a certain method, construct a new feasible solution. New feasible solution to judge if their fitness has improved, then this mutation is beneficial, this variation in the population have the opportunity to go on genetic; otherwise it is useless variation, it will be eliminated[4].

For two parent individuals mutating in its chromosome matrix randomly selected two lines and switching elements of two lines, it can produce a new individual. Therefore, in this article, any new solution of a feasible solution generated through this mutation are also a feasible solution.

Tab4. The process of mutation

parent	Room1	Room2	Room3
Time1	(Cid1,Sid1,Tid1)		(Cid2,Sid2,Tid2)
Time2		(Cid3,Sid3,Tid3)	(Cid4,Sid4,Tid4)
Time3	(Cid5,Sid5,Tid5)		

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offspring	Room1	Room2	Room3
Time1	(Cid5,Sid5,Tid5)		
Time2		(Cid2,Sid2,Tid2)	(Cid4,Sid4,Tid4)
Time3	(Cid1,Sid1,Tid1)		(Cid3,Sid3,Tid3)

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