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Original Research Article

Computer Intelligent Test Paper System Based on Genetic Algorithm

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Abstract: The rapid development of the Internet has brought tremendous changes to people's lives. Through the network function, the online examination is gradually accepted by various educational and teaching institutions. Currently, online exams have become the main method of teaching evaluation. In order to solve the problem of intelligent test paper more effectively, this paper proposes a mufti-threaded intelligent test paper strategy based on genetic algorithm, and designs the computer system structure in the standard test question bank. Convergence simulation and experimental results show that the algorithm is better than simple particle swarm optimization algorithm, simple genetic algorithm and its improved algorithm. Established a mathematical model and objective function for test paper composition, and proposed an intelligent test paper composition strategy based on genetic algorithm. The investigator used overall coding, crossover and mutation operations to improve the global optimization capability and convergence speed. It overcomes the phenomenon of premature and improves the accuracy and speed of convergence. It has the advantages of strong optimization ability and good stability.

Keywords: Genetic Algorithm; Intelligent Test Paper Generation System; Test Paper Generation Algorithm

1. Introduction

With the continuous development of information technology, computer technology has become an indispensable part of our lives. In the test system, test papers are an important part of the test system, and genetic algorithm is a common testing method system. However, automatic examination paper has an important function, which determines whether the system can effectively evaluate the student's performance system.

With the continuous advancement of Internet technology, many experts have conducted research on genetic algorithms and computer intelligence composition. Introduced a method of generating paper based on genetic algorithm. The genetic algorithm coding method of this model is proposed, which can store the fitness value of a single test paper and various attribute indicators. A piece wise multipurpose hybridization strategy is proposed for the crossover operator. The use of large crossover and mutation rate maintains the diversity of the population, analyzes the shortcomings of the standard genetic algorithm in global optimization, points out the main improvement directions of the genetic algorithm, and points out the key operations in mulch-objective optimization, such as constraints, etc. Select genetic algorithm as the test paper algorithm[1]. Some experts have studied the method of intelligent test paper generation based on genetic algorithm, expounding the basic and main principles of test paper generation. According to the characteristics of high school mathematics exams, the constraint conditions in the process of composing test papers are summarized, and a mathematical test paper generation model based on genetic algorithm is established using eclipse development tools. Through the analysis of the current situation and development trend of intelligent test paper generation at home and abroad, it is proposed that genetic algorithm can solve the constrict problem in the process of intelligent test paper generation, and complete the test paper scientifically, efficiently and reasonably. It provides a reference method and idea for the application of genetic algorithm in the question of test paper[2]. Some experts have studied the design and implementation of an intelligent test paper generation system based on genetic algorithms, analyzed the advantages and disadvantages of several commonly used test paper generation algorithms such as random test paper generation algorithm and retrospective test paper generation algorithm, and put forward the theory of selecting genetic algorithm as the test paper generation algorithm in accordance with. Aiming at the problem of intelligent test paper composition, many important performance indicators and their relationships are analyzed. Based on the characteristics of genetic algorithm's global optimization and fast convergence speed, the genetic termination condition of

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the algorithm was determined, and the test paper generation system was tested, focusing on the application of genetic algorithm in combination optimization, and compared with random algorithm. The superiority of genetic algorithm. Finally, the specific design of intelligent test papers is realized, such as the design of database and genetic algorithm, the selection operator, crossover operator and mutation operator of the algorithm are designed, and the system is tested and run[3]. Experts have studied the research and implementation of an intelligent test paper composition system based on genetic algorithms, established a mathematical model of automatic test paper composition with knowledge points, difficulty, and question types, and analyzed the intelligent automatic test paper composition with teaching demand as the main control parameter. Questions and commonly used test paper formation algorithms, an improved genetic algorithm is proposed, according to the characteristics of the test paper formation problems, the method of segmented integer coding is adopted. According to the coding strategy, crossover operator and mutation operator are designed. The simulation test shows that the intelligent test paper generation algorithm based on the improved genetic algorithm can meet the requirements, and the application of the improved genetic algorithm in the intelligent test paper generation problem is introduced[4]. Although people have made great achievements in the research of the genetic algorithm-based test paper generation system, there are still some shortcomings in the practical application of the genetic algorithm-based computer intelligent test paper generation system.

In order to study the computer intelligent test paper composition system of genetic algorithm, this paper has conducted research on genetic algorithm and found the solving function of genetic algorithm. The results show that genetic algorithm can be applied to the actual test paper composition.

2. Method

2.1 Genetic algorithm

Genetic algorithm is a computational model that simulates Darwin's genetic selection and natural elimination evolution process. The genetic algorithm starts from the population representing the potential solution set of the problem. The population consists of a certain number of individuals encoded by genes. It is an iterative search algorithm with "survival + detection". Genetic algorithm is a robust search algorithm. When using genetic algorithm to solve the problem, its basic idea is to simulate the evolution process of a population composed of genetic codes. Genetic coding is the basis of genetic algorithms. The genetic algorithm does not directly discuss the research object. If there are answers to multiple questions, but to find an optimal answer, it can be used for complex system optimization. It is a string that arranges specific symbols in a certain order through a certain encoding mechanism, derived from biological genetics and the natural law of survival of the fittest. Then use genetic algorithms to get faster and better results. It can be called the mapping from the problem space to the genetic algorithm space[5]. Genetic algorithm is usually used to solve the optimal solution in the solution set of the problem. After determining the coding scheme, fitness function and genetic operator, it is not a simple random walk. The genetic algorithm is based on the evolution process. The goal of the genetic algorithm is to assign the nodes in the graph to the processor appropriately. To minimize the total execution time of the program. The biological evolutionary process of selection and natural elimination. Selection refers to the operation of selecting certain individuals in a group, which is a survival mechanism based on fitness[7]. The genetic algorithm reorganizes the adaptive string by randomly exchanging information. In each generation, a new string padding is generated using the adaptive bits and segments of the previous generation. It can effectively use existing information to search for strings that hope to improve the quality of the solution.

2.2 Solving function by genetic algorithm

In order to effectively design the fitness function suitable for the test paper generation problem, the objective attributes are weighted and combined as the objective function, and the overall fitness value is calculated as: $w_i \sum w_i = 1$. The objective function is designed by piece wise function. Its basic definition e_i is shown in formula (1), where m_i is the attribute value of each target and is the error range.

$$f_i = \begin{cases} \left|\frac{a_i - e_i}{e_i}\right|, \frac{a_i - e_i}{e_i} \le m_i \\ 1, \frac{a_i - e_i}{e_i} > m_i \end{cases} \quad (1)$$

According to the weight distribution of objective attributes, the objective function of the whole test paper can be expressed as follows:

$$f_{\min} = \sum^{n} w_i f_i \quad (2)$$

$$F = \exp(-fi) \quad (3)$$

In order to effectively maintain the diversity of population in the actual calculation process, the exponential proportional

transformation method is introduced into the transformation of fitness function, that is, the fitness function is transformed into the objective function by using formula (3).

3. Experience

3.1 Extraction of experimental objects

By simulating different types of typical test questions, a sample library was established [8]. The test question index is the basis for establishing a test question bank. As an optimal solution, genetic algorithm needs to design a good individual pros and cons evaluation function, which is also called fitness function. The index of the test paper is also a key factor in the process of forming the test paper. When the user puts forward the test paper requirements, he cannot put forward requirements for a single test paper index, but can put forward relevant requirements for the entire test paper.

3.2 Experimental analysis

In order to realize intelligent test paper generation, the key problem is to meet the requirements of the test paper makers. Among these requirements, the most important ones are:

(1) the proportion of knowledge points in the test paper (the score ratio used in this paper);

(2) the difficulty requirements;

(3) the number of various types of questions[9]. In the initial test paper generation constraints, also due to the size of the test question bank, the intelligent test paper generation system can not generate papers correctly in order to improve the processing ability of the system. Through the conceptual design of the system database, the concept model of idle is obtained. Therefore, according to the percentage of knowledge points in the whole test paper and the distribution of knowledge points in the test paper, the success rate of test paper formation is improved. In order to improve the processing ability of the system and maintain a good applicability of the system, the system adopts advanced logical independent structure in the design process, At the same time, the random test paper generation option is added as a supplement to the genetic algorithm intelligent test paper generation. Further improve the hit rate of data resources to ensure the accuracy and timeliness of database operation. The three principles of setting problems are formulated by users themselves[10]. Aiming at the problem of mufti constraint test paper generation, the mathematical model of intelligent test paper generation is established, $m \times n$ and the problem is solved quantitatively. Suppose that a group of test papers is composed of M questions, and each question contains n attributes, then the test paper can be represented by an attribute matrix s, that is $s = (s_i)^T, 1 \le i \le m$ where represents the I test question. The test paper structure matrix can be formally expressed as formula (4):

$$s = \begin{bmatrix} a_1 & a_2 & \dots & a1_n \\ a_2 & a_2 & \dots & a_{2n} \\ & & & \\ a_{m1} & a_{m2} & \dots & a_m \end{bmatrix} \tag{4}$$

The test paper matrix s represents the a_{ij} attribute of question I, each row represents a test question, and each column represents an attribute of the test question. The attribute of each test question is n = 7, and the order is: difficulty, knowledge point, score, question type, cognitive level, time and exposure.

4. Discussion

4.1 Experimental simulation and result analysis

Through the comparative analysis of test paper composition time, test composition efficiency and test paper composition objective function value, the computer-aided testing system is used to test the learning effect of students. The system includes multiple functional modules, and its core function is constraint-based volume formation. It shows that the EWTR method has better performance. 1000 questions in the computer system structure course are set up in the standard question bank. The question types in the test questions include multiple choice questions, fill-in-the-blank questions, true or false questions, short answer questions, discussion questions and calculation questions. In the experiment, there are test paper methods based on SDA, FDF and SFF. The distribution of these problems is shown in **Table 1**.

Table 1. Distribution of test questions

choice question	Completion	True or false	Short answer questions	Discussion questions	Calculation questions
312	105	54	214	145	170

It can be seen from the above that there are 1000 questions in this examination, including 312 multiple choice questions, 105 blank filling questions, 54 judgment questions, 214 short answer questions, 145 discussion questions and 170 calculation questions.

4.2 Analysis of the factors affecting the efficiency of generating test papers by genetic algorithm

As one of the control parameters of genetic algorithm, population size also affects the performance of genetic algorithm. We

set the population size at 11,12,13,14,14,16,17,18,19 and carried out a lot of experiments. The experimental data are shown in Figure 1.

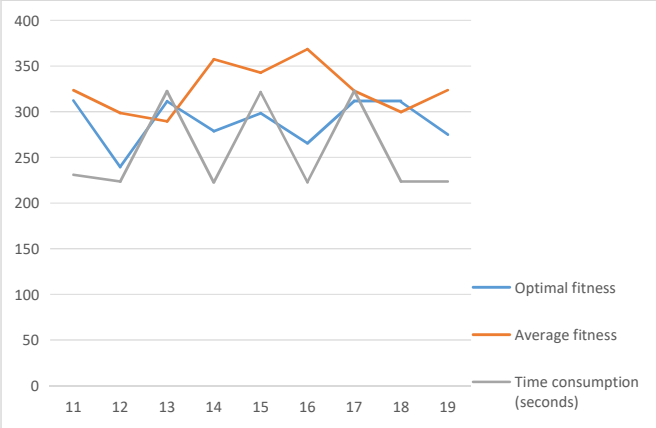

Figure 1. Effect of population size on algorithm efficiency.

As can be seen from the figure above, the best fitness of the serial number 11 is 312.23, the average fitness of the serial number 17 is the highest, and the average fitness of the serial number 12 is the lowest; the best fitness of the serial number 16 is the highest, and the best fitness of the serial number 13 is The best fitness is the lowest.

4.3 Examination management module

For a certain examinee, when judging all the questions of the examinee, the score of the next examinee can be evaluated according to the above steps. We investigated 50 students. When all candidates' scores have been evaluated, you can click the "analysis" button on the test analysis page to automatically analyze and count the test. The analysis results are shown in **Figure 2**.

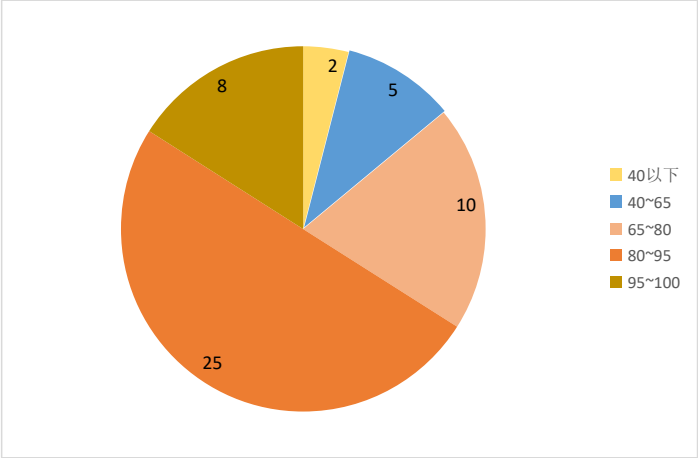

Figure 2. Proportion of people in different sections.

As can be seen from the above figure, the number of people with scores between 80 and 95 accounts for 50% of the total number of people, and the number of people with scores between 65 and 80 accounts for 20% of the total number of people. The number of people who scored 80-95 was the most.

In this case, you can click the statistics button of "background statistics" to view the relevant information of the test paper, such as the "test paper statistics" in the "background" button, such as "test paper information statistics", such as "test paper information statistics", such as "test paper information statistics", such as "test paper statistics table". As shown in **Table 2**.

Table 2. Test paper statistics page

Objective of investigation	memory	understand	Simple application	Comprehensive application
percentage	22%	15%	19%	44%
Degree of	C	B	D	A

It can be seen from the above table that the difficulty of memorizing the question type is C, accounting for 22%, the difficulty of understanding the question type is B, accounting for 15%, the difficulty of simple application is D, accounting for 19%, and the difficulty of comprehensive application is a, accounting for 44%. The proportion of comprehensive application questions in the whole test paper is the highest.

5. Conclusion

Test paper generation is a parameter optimization problem with multiple objectives and multiple constraints. Aiming at the lack of quality and speed of intelligent test paper composition, the realization of genetic algorithm in intelligent test paper composition is mainly discussed. By analyzing the principles and key technologies of the standard genetic algorithm, the existing genetic algorithm is optimized. The genetic algorithm is improved on the basis of the original genetic algorithm. Through a large

number of experiments, the algorithm is compared with the serial genetic algorithm, which proves the rapidity and superiority of the algorithm. The basic genetic algorithm was improved twice, and the crossover probability and mutation probability of the genetic algorithm were adjusted according to the degree of individual adaptation. This not only does not destroy the highly adaptive individual structure, but also overcomes the slow search speed, thereby effectively improving the speed and quality of the test paper. Can be applied to the actual volume. At the same time, a hybrid genetic algorithm is proposed. Through the development of the elite strategy, according to the characteristics of the applied school automatic control theory, a test question bank and mathematical model for intelligent test paper composition are established.

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