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Analysis of the Construction of Multimedia Networks for English Teaching Methods with Improved Genetic Algorithm

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ABSTRACT

This article studies the teaching mode of college English in a network environment based on genetic algorithms and multimedia technology. With the development of information technology, the online environment provides new opportunities and challenges for English teaching. In this environment, students can access more learning resources, but at the same time, they also need to have a certain level of information literacy and learning ability. Therefore, exploring teaching models that adapt to this environment has important practical significance. The study adopted methods based on genetic algorithms and multimedia technology to analyze the English learning process in a network environment and develop a teaching plan more aligned with students' needs. This plan fully considers factors such as students' learning styles and cognitive levels and adopts various teaching strategies, such as situational and cooperative learning. At the same time, the study also utilizes multimedia technologies such as speech recognition and artificial intelligence to provide students with a more personalized and intelligent learning experience. This teaching model improves students' English proficiency and cultivates their autonomous and cooperative learning abilities.

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1. Introduction

The optimal global value of the genetic algorithm and other characteristics of GA are related to the non-linear and multi-objective requirements of many management factors, such as teaching objectives, courses, and teaching staff in college English management. Therefore, the college English teaching mode study has a good theoretical basis using a genetic algorithm [1]. Since its birth in the last century, genetic algorithms have been widely used in fields closely related to the work of human life. The Darwinian theory of evolution and Mendelian genetics, as representative results of genetic algorithms, make an irreplaceable contribution to the development and progress of society. [2]. The research of genetic algorithms has been carried out for more than 50 years. Among them, the genetic algorithms that can be used to solve the problem of adaptive optimization calculated by complex systems effectively in the 60s of last century laid an important theoretical basis for the research of modern genetic algorithms [3]. Genetic algorithm in the face of problems, by choosing the coding scheme, the choice of fitness function genetic operators and other parameters are selected. A better next-generation sample is obtained by selecting crossover, mutation and other operations, and the best results can be obtained by the model self-organization search [4]. The genetic algorithm avoids the space limitation of other algorithm searching. It selects the initial point from the feasible solution space so that the local optimal value will not appear in the algorithm. Genetic algorithms introduce genetic factors in the global search, which allows the new generation to maintain the optimal structure [5]. Therefore, based on the genetic algorithm study, the college English teaching model has a good theoretical basis.

2. The State of the Art and Background

The characteristics of a self-adaptive genetic algorithm and the ability to automatically discover the laws of the environment are very suitable for the changing state of things in their development [6]. The biggest advantage of the genetic algorithm is efficient global parallel search. During the search process, the model proactively acquires and accumulates knowledge in the search space and adaptively controls the search process to achieve the best solution [7]. Genetic algorithm uses multiple iterations based on the fitness of individuals in different problem domains. Continuous selection, crossover and optimization processes are used to find new approximate solutions. This truly simulates the whole process of population evolution in the natural environment, enabling the new individual to reflect the requirement of better adaptation to the environment than the past individual. Genetics can play a role in continuously improving the pooling of optimal populations. The good structure is kept to the next generation, or better structures will be produced [8]. Genetic factors can timely respond to the changes in teaching contents, courses and teaching methods and effectively reduce the possible local optimization problems in searching for the best teaching mode. Therefore, based on the genetic algorithm, the study of the college English teaching model has good application value [9]. Genetic algorithms can take advantage of mathematical models and mathematical logic. It can help manage behaviour change from qualitative analysis in the past to quantitative analysis based on a mathematical algorithm and make the indicator of teaching management develop in the direction of artificial intelligence management.

The English teaching model must be reorganised and designed when it cannot meet students' training objectives and needs in multimedia and network environments. Therefore, this article mainly uses genetic algorithms to optimize and improve college English teaching methods. Genetic algorithms simulate the biological genetics and natural selection mechanism under the search algorithm to help teach courses become more oriented and targeted. The genetic algorithm's fitness calculation is mainly based on improving crossover probability and mutation probability calculation formulas. So, the adaptive genetic algorithm can be enhanced, global search capabilities can be improved, and local search capabilities can be improved. Genetic algorithm optimization effectively ensures the breadth of population search, lets the population focus on search and evolution in some areas to get the optimal solution, and advances evolutionary strategy. In the past, some scholars used the basic genetic algorithm to use binary and real numbers as the encoding method. This basic search needs to modify the original sample to adapt to the structure of the genetic algorithm. It takes much time to encode and decode the genetic algorithm. The efficiency and the cycle have a great impact [10]. Therefore, this thesis is devoted to optimising genetic algorithms in the research, making the algorithm more suitable for the design of teaching curricula and promoting the efficiency and quality of teaching model design.

3. Methodology

3.1. Genetic Algorithm

A genetic algorithm is a kind of intelligent artificial algorithm which embodies the law of nature of "survival of the fittest and discomfort is eliminated". It is the wisdom achievement of the continuous evolution of human society. The theoretical basis of the algorithm is to use the mathematical model to simulate the process of biological evolution. The genetic algorithm brings the process of selecting the optimal solution into the process of biological evolution, taking the sample population as the representative of the problem and the genetic factors into the sample population. A new population generation is obtained after choosing, crossing, mutation and other *operations. The optimality will be repeated iterative search training, and the maximum fitness individuals will be finally chosen as the optimal solution. Simple Genetic Algorithms (SGA) is an important basic algorithm for improving genetic algorithms. It generally includes the main processes of coding, establishing the initial population, evaluating individual fitness and choosing design genetic operators. The basic genetic algorithm design process is shown in Figure 1.*

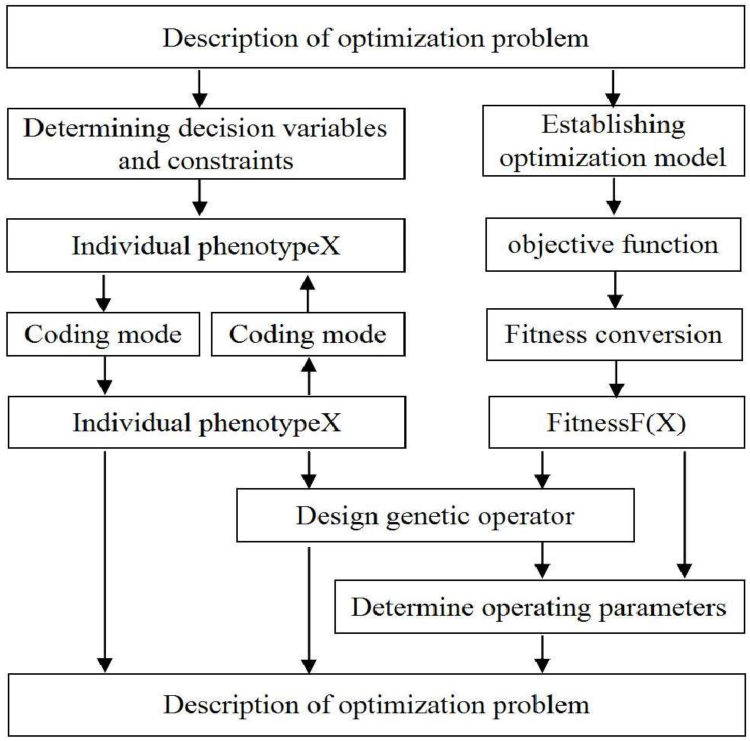

Figure 1. Schematic diagram of the genetic algorithm design process

In the basic chromosome encoding, the genetic algorithm uses a binary encoding. The binary symbols of fixed length are generally used to represent different individuals in the population, and the corresponding genes also consist of symbol sets. The genetic algorithm of the individual tree structure encoding is shown in Figure 2.

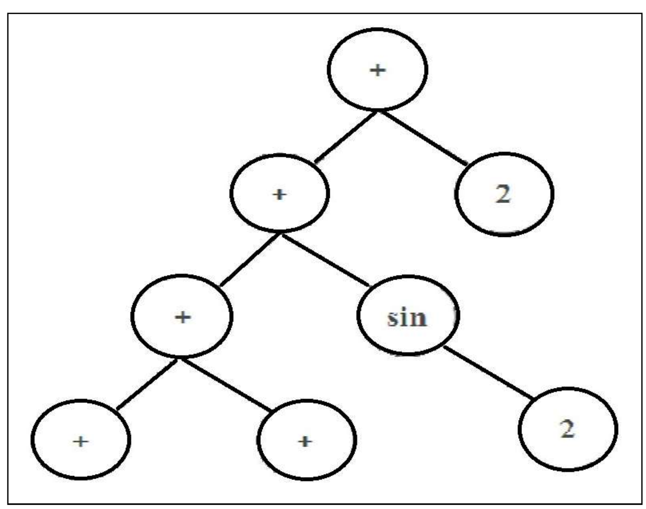

Figure 2. Individual tree structure coding graph of genetic algorithm

In designing genetic operators, the reasonable range and size of the genetic algorithm parameters need to be finally set through multiple experiments. This article describes the calculation of operator selection by using roulette. The probability of each individual entering the next generation is determined by the ratio of the individual's fitness to the sum of the individual's fitness in the entire population. The greater the individual fitness value, the higher the probability of being selected and entering the next generation. Assume the population size is M, and the individual's fitness value i is expressed as f_1. The probability that an individual is selected is calculated using equation (1).

$$P_i = \frac{f_i}{\sum_{i=1}^{M} f_i} \quad (1)$$

The process first calculates each fitness value f_1 of population individuals and $i = 1,2, ..., M$. The sum of the fitness of all individuals in the population is calculated by the formula (2).

$$F = \sum_{i=1}^{M} f_i \quad (2)$$

The probability of choosing individuals is calculated using the formula (3). The above steps are runner methods. The selection process is to choose the M-turn process. Each time, a new individual has to be chosen to join the new population. Set the pseudo-random number r, which is evenly distributed in the interval [0,1]. When in $r \le q_1$, the first individual is selected. Otherwise, the kth individual is selected ($2 \le k \le M$), and $q_{k-1} \le r \le q_k$ is set up. Then the M selection process is conducted to derive the genetic operator.

$$P_k = \frac{f_k}{\sum_{i=1}^{M} f_i} \quad k = 1, 2, L\ M \quad (3)$$

In the initial population selection, the genetic algorithm will randomly select the initial population of the object at the beginning, and the selected value is from 20 to 100. In the constrained optimization problem, the initial population should be based on diversity, randomness and evenness to ensure the feasibility of the individual population. Under this requirement, reaching the target by randomly selecting the population isn't easy. In the case of many dimensions and constraints, only applying the stochastic algorithm will prolong the selection time of the initial population and directly affect the efficiency of the genetic algorithm. Therefore, two aspects of the research on generating the initial population are proposed in this paper. One is that the initial population is generated using internal modification based on the points in the feasible field. Second, if a man cannot give an initial point, a scientific search is used to find a point. The search process for the initial population is shown in Figure 3.

Here $x_1^{(1)}$ is the point of the interior of the feasible region, which is the initial interior point of the request. After the initial population seeking the first individual x_1, the subsequent individuals $x_2 = [x_1, x_1,..., x_n]$ are randomly generated. If x_2 is a viable individual, continuing transmitting the next individual x_3. If x_2 is not feasible individuals, adjusting it according to $x_2 \Leftarrow x_1 + a(x_1 + x_2)$. Here α is the contraction factor, and the value of the choice between [0,1]. When $\alpha = 0.5$, the new point in the position between x_1 and x_2 will be gotten. Then, all the needed points in the initial population will be found using the same method.

3.2. Genetic Algorithm Optimization

Although the genetic algorithm has the advantages that other algorithms don't have, there are also inherent deficiencies in the algorithm. The genetic algorithm adopts the method of fixed strategy parameters, which results in poor search results. There is no way to solve the problem of changing the strategy parameters and the dynamic in the genetic evolution. The outstanding performance is that the crossover and mutation probability cannot be controlled. Therefore, the basic genetic algorithm cannot objectively reflect the evolution of populations in different periods of different changes in the state.

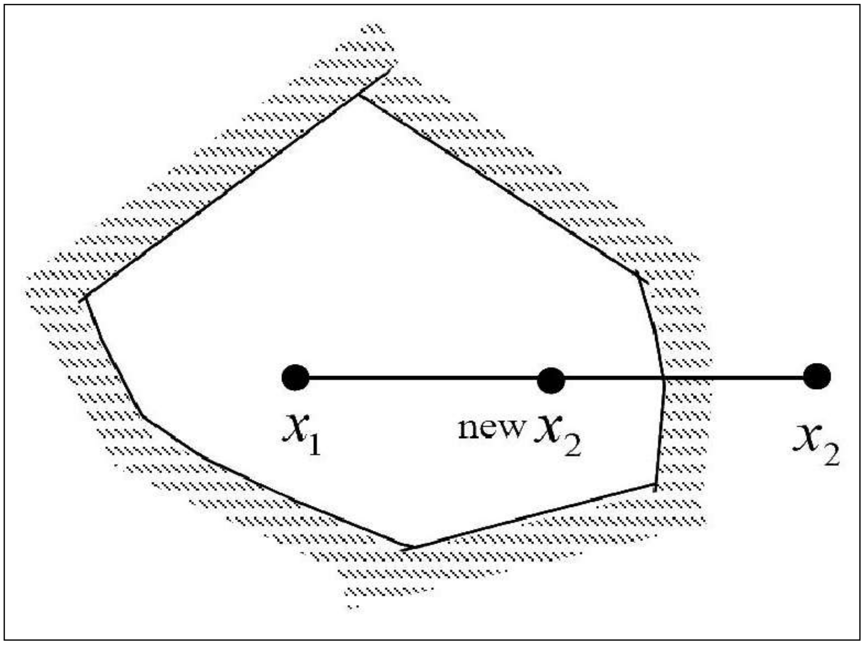

Figure 3. The relationship between the new individual and the original individual

This omission of the evolutionary state of the population when the environment changes also ignore the self-adaptive characteristics of individual growth and genetic behavior will follow the change. It will bring the problems of low performance and efficiency of the algorithm leading by the unchanged genetic algorithm parameters. After analyzing the principle, advantages and disadvantages of the basic genetic algorithm, it is found that the parameters greatly influence the performance of the genetic algorithm. If the parameters are fixed, then how to ensure that the right choice is a major issue. If the parameter selection is not suitable for different problems, genetic algorithms will be different conclusions. Aiming at the deficiency of the genetic algorithm, this paper proposes an improved algorithm of crossover probability and selection probability of adaptive degree.

$$P_c = \begin{cases} P_{c\_max} - \left(\dfrac{P_{c\_max} - P_{c\_min}}{it\ max} \right) * iter & f^1 \geq f_{avg} \\ P_{c\_max} & f^1 < f_{avg} \end{cases} \qquad (4)$$

$$P_c = \begin{cases} P_{c\_min} + \left(\dfrac{P_{m\_max} - P_{m\_min}}{it\ max} \right) * iter & f^1 \geq f_{avg} \\ P_{c\_min} & f^1 < f_{avg} \end{cases} \qquad (5)$$

In order to solve the problem that crossover probability and mutation probability cannot change dynamically, genetic algorithms that dynamically adjust crossover probability and mutation probability according to fitness value is proposed. Adjustment formula is shown in formula (4), (5) below. In the formula, the cross probability is expressed as p_c, p_{c_max} is the maximum cross probability, p_{c_min} is the minimum cross probability, p_m is the maximum mutation probability, the p_{m_max} is maximum mutation probability and p_{m_min} is the minimum mutation probability. itmax is the maximum evolution algebra, iter is the current evolution algebra, f_{avg} is the average population fitness index, f^1 represents the individuals with large fitness of crossover operations and f represents the fitness of individuals who need to carry out mutation operations. The optimized genetic algorithm p_c and p_m can automatically change with the fitness value, but p_c and p_m will be close to or equal to zero when the individual fitness value is close to or equal to the maximum fitness value. Suppose the algorithm is in the early stage of evolution. In that case, it will appear that the good individuals are almost invariant, which leads the whole algorithm to look for the local optimal solution. Therefore, the algorithm continues to be optimized.

$$p_c = \begin{cases} p_{c1} - \dfrac{(p_{c1} - p_{c2})(f^1 - f_{avg})}{f_{max} - f_{avg}} & f^1 \geq f_{avg} \\ p_{c1} & f^1 < f_{avg} \end{cases} \quad (6)$$

$$p_m = \begin{cases} p_{m1} - \dfrac{(p_{m1} - p_{m2})(f^1 - f_{avg})}{f_{max} - f_{avg}} & f^1 \geq f_{avg} \\ p_{m1} & f^1 < f_{avg} \end{cases} \quad (7)$$

The fitness formula is improved to formula (6), (7). Among them, f_{max}, f_{avg} represents the value of the largest individual fitness, f_{avg} is the average fitness, and f_1 represents the higher fitness in the cross-operation of two individuals. $p_{c1} = 0.9$, $p_{c2} = 0.6$, $p_{m1} = 0.1$, $p_{m2} = 0.01$ is set. In this way, the crossover probability and mutation probability of individuals with the maximum fitness in the population cannot be zero. So that good individuals can be in a state of always changing and help the genetic algorithm to achieve global search to select the optimal solution.

Data structure coding method is adopted, and the three-dimensional data structure is used to represent the algorithm alleles and can accurately grasp the essence of the problem. It does not require complex decoding operations, and coding makes the teaching course information becomes intuitive and image. The fitness calculation program will not be too complicated. The three-dimensional array of alleles is shown in Figure 4. It uses cubic coordinates to represent a three-dimensional array. The X-axis is the time axis, and each interval corresponds to a time interval. For example, X1 and X2 represent the time periods of the first and second training courses on Monday morning. Arrangements are made for a teaching cycle of 5 days a week with 5 classes per instructional day, and 25 coordinate values $(X_1, X_2 L, X_{25})$ corresponding to the X-axis. The Y-axis represents the training classroom, and one for each classroom is available. The Z axis represents the content of the training course, with each coordinate representing a course object. Each course object includes teachers, courses, teaching objectives and other information.

4. Result Analysis and Discussion

Currently, the forms of college English teaching in multimedia technology and network environments are relatively universal, laying a good foundation for using the basic information data to study college English teaching mode. To enable schools to analyze and evaluate the

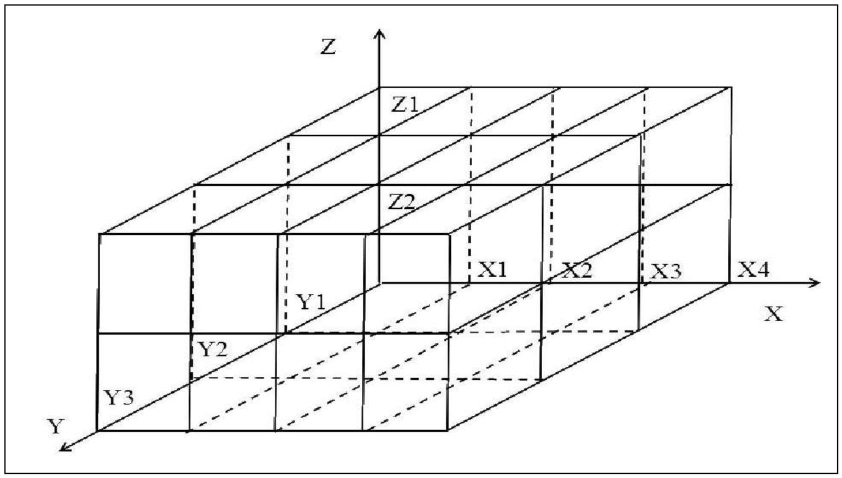

Figure 4. Three dimensional structure of alleles

English teaching model quantitatively and to effectively allocate curriculum resources and teaching methods according to the teaching objectives, this paper presents a simulation experiment based on the genetic algorithm in M University for English teaching mode. The experiment sets the ideal parameters and generates simulated teaching sample data according to this set of ideal parameters, Then the genetic algorithm is used to optimize the sample data and compares it with the pre-set ideal parameters to test the effectiveness of the proposed algorithm. The number of experimental population is 100, the number of parameters is 50, the unit string length is 8, the mutation probability is 0.4, the crossover probability is 0.3, the weight is 0.5 and the number of samples is 100000. Part of the experimental data generated is shown in Table 1.

Generation	Evaluation Error of Optimal Solution and Ideal Value	Evaluation Variance of Optimal Solution and Ideal Value
0	0.237801	0.304212
60	0.064619	0.079817
100	0.031789	0.037737
160	0.013713	0.017816
200	0.008341	0.011675

Table 1. Optimal Solution Error

In order to compare the search task completion time of teaching data set under the condition of Internet,a set of data set which contains 10 sets of data {100, 200, 300, 400, 500, 600, 700, 800, 900, 1000} is set. In the simulation test, the empirical design, ant colony algorithm and the optimization genetic algorithm in this paper are compared. Basic data and virtual machine configuration, etc. all use the same conditions. Under this condition, the contrast of this algorithm test can be gotten. Figure 5 shows comparison chart of the data collection task execution time. The abscissa here is the number of task sets, and the vertical coordinates represent the completion time of the task. It can be seen from the figure that the optimized genetic algorithm proposed in this paper is suitable for a small number of previous tasks and the execution time steadily increases. In the latter stage of the task to increase the size of the scene becomes complex cases, but also according to the algorithm model optimization iterative search for the global optimal solution. So, we can see that the proposed genetic algorithm proposed in this paper has a great advantage in optimal pattern search completion time.

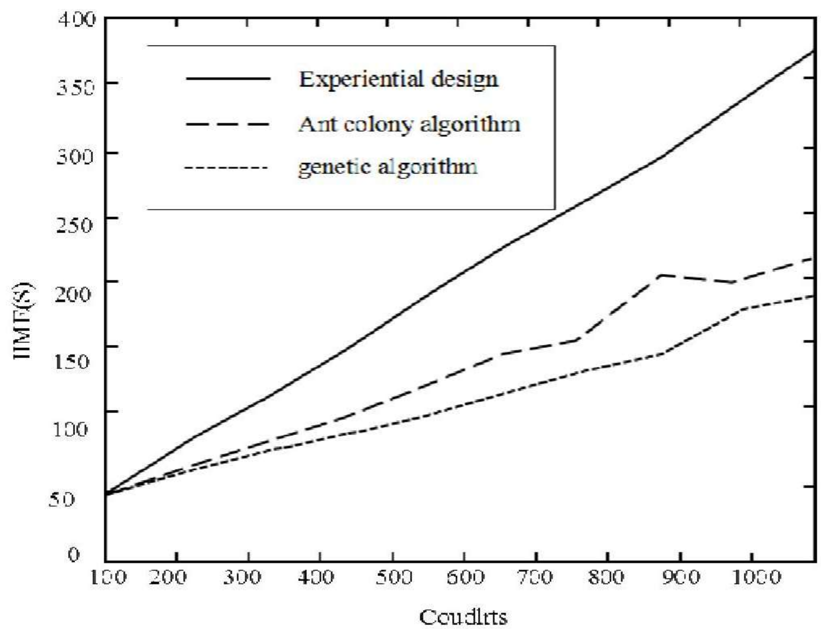

Figure 5. Small data task execution time contrast diagram

In order to validate the performance of the optimization task based on the optimized genetic algorithm in processing network environment with large data size, this paper selects three groups of big data of curriculum and teaching content for testing. The result is shown in Figure 6. As can be seen from the figure, the optimal genetic algorithm proposed in this paper has some differences in the degree of optimization when the number of large data tasks and the task complexity are different, but all have the advantage of optimizing the time performance. The advantage will be even more obvious when the data size added.

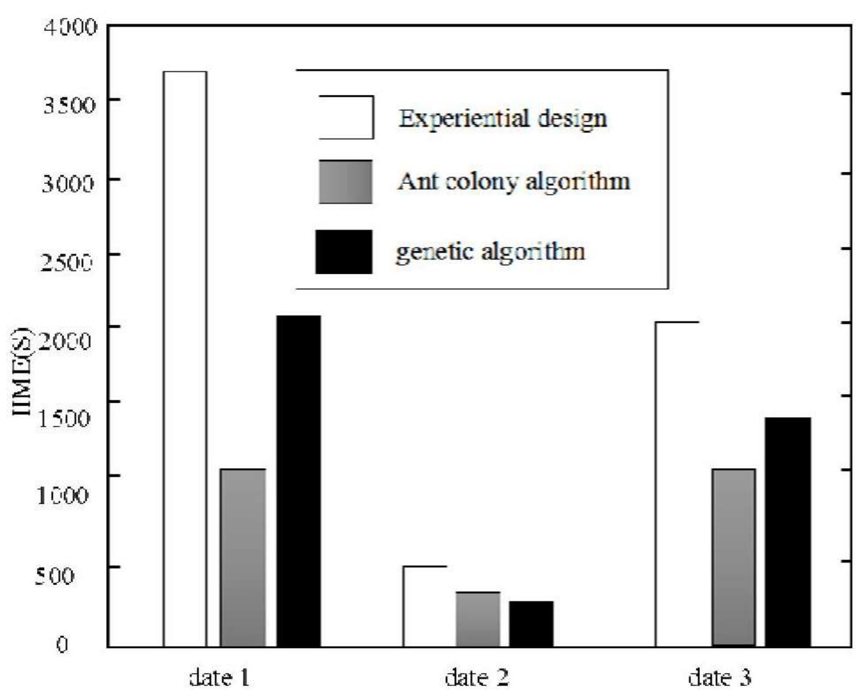

Figure 6. Contrast chart of big data task execution time

5. Conclusion

Genetic algorithm is an artificial intelligence model that learns the optimization strategy of human evolution and biological inheritance. In data mining, image processing, management, optimization and other fields, it has been widely used. In this paper, multimedia technology and network environment teaching mode are studied based on the genetic algorithm. Mainly through the optimization of multi-objective problems such as teaching courses, teaching content, the advantages of genetic algorithm computing efficiency is reflected. On the basis of analyzing the computing process and the realization process of genetic algorithm, this paper improves the algorithm of genetic algorithm based on the optimization problem of local optimization. The adaptive formula of crossover probability and mutation probability under dynamic index is proposed. From the needs of English teaching model research, the data structure of the allele encoding is explored and updated. Finally, computer-aided technology is used to simulate the algorithm implementation. From the verification results, the results of the optimization based on genetic algorithm college English teaching model and teaching objectives can be formulated to meet the requirements of a variety of goals under the teaching program, which also shows that the study of the English teaching model based on genetic algorithm is successful. Of course, the test results also show that the optimization of the genetic algorithm has room for improvement, and further improving the model's accuracy is the study's direction.

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