Application of Genetic Algorithms in Project Declaration

Shanshan Wang¹, Ziping Zhao¹a, and Yu Qiao¹
¹Tianjin Normal University College of Computer and Information Engineering, Tianjin, 300387 China
a Ziping Zhao: ztianjin@126.com

Abstract. With the development of information technology, the arrival of era of big data, the scale of scientific research has been expanded continuously in universities, and the level of scientific research has been improved continuously. Nowadays, new demands are placed on scientific research management. In the scientific research management platform, the Genetic Algorithms has been applied well. Especially, the Genetic Algorithms has a better embodiment in expert detection of the project declaration subsystem. In order to solve the problem that a large amount of manpower is needed in the process of scientific research project review, we mainly analyze the application of Genetic Algorithms and use Genetic Algorithms to solve the problem of project management in scientific research management.

1. Introduction
The era of big data has brought great convenience to our lives, and has also greatly promoted economic development and social progress. How to manage various scientific research information generated in scientific research management effectively, which it enhances the competitiveness of scientific research between countries, becomes more and more important [1][2]. In this regard, scientific research personnel are required to process and store data in a timely manner in the university scientific research management system database to facilitate real-time access and scheduling.

Scientific research management is a science that with the gradual development of science and technology, adopts some advanced technologies to manage scientific and technological work. University scientific research management work includes many aspects, no matter what is the arrangement and design of the program, the collection and processing of data, the screening of a large number of documents, and the investigation and processing of data. All of them need to serve the students. Only students can learn to verify the results. Allowing students to analyze, then we can teach students from the scientific research [3].

There is an old saying in China that “Everything is difficult at first”, so, the project application subsystem is particularly important in many scientific research management tasks. Genetic Algorithms have been used widely in portfolio optimization, machine learning, signal processing, adaptive control, and artificial life. It is a key technology in modern intelligent computing, so it has a certain degree of persuasion. The Genetic Algorithms uses the objective function as search information directly and applies probabilistic search techniques, thereby making the search process more flexible. At the same time, the method can perform parallel calculations, so it can increase the computational speed through large-scale parallel computing, and is suitable for the optimization of large-scale and complicated problems. Based on this, we mainly discuss the application of Genetic Algorithms in the optimization of university science research management project declaration system and its concrete embodiment as follow.
2. GA(Genetic Algorithms)
The Genetic Algorithms \cite{4} (GA) is a parallel random search optimization method that imitate the natural genetic mechanism and biological evolution theory proposed firstly by Professor J. Holland of the United States in 1975. It introduces the biological evolutionary theory of “survival of the fittest” into the coding concatenated population of optimized parameters, and screens the individuals according to the selected adaptability function through the replication, crossover and mutation in the inheritance so that the degree of compliance is high. Individuals are retained to form new groups, the new group inherits both the previous generation's information and the previous generation\cite{5}.

Genetic Algorithms is simple and can be processed in parallel, and the global optimal solution can be obtained. It is an optimization method\cite{6} by which you can try to find the right input value, and through these input values getting the best effect output value. That is, the part you originally wanted, thus changing the input value and you can get better output values. By copying, crossing, and mutating operations, it is worth noting that

![Application system diagram of genetic algorithm in project declaration.](image)

Figure 1. Application system diagram of genetic algorithm in project declaration.

the entire process is the operation of the encoding of the parameters rather than the parameters themselves, the searching information of multiple search points can be used at the same time. This implicit parallelism can make the search efficiency of the algorithm is high.

The basic operation of Genetic Algorithms\cite{7} is as follows:

1. Initialization: Set the evolution algebraic counter \( t = 0 \), set the maximum evolutionary algebra \( T \), randomly generate \( M \) individuals as the initial population \( P(0) \).

2. Individual evaluation: Calculate the fitness of each individual in the population \( P(t) \).

3. Select operation: The selection operator acts on the group. The purpose of the selection is to directly pass on the optimized individuals to the next generation or to cross-generate new individuals through the pairing and then to the next generation. The selection operation is based on the individual's fitness assessment in the population.

4. Crossover: The crossover operator acts on the group. The core of the Genetic Algorithms is the crossover operator.
(5) Variation operation: The mutation operator is applied to the population. That is, the gene values at certain loci in individual strings in the population are changed. The population $P(t)$ gets the next generation $P(t+1)$ after selection, crossover, and mutation operations.

(6) Termination condition judgment: If $t = T$, the individual with the greatest fitness degree obtained during the evolution process is output as the optimal solution, the calculation is terminated.

3. Application
How to strengthen the process management of scientific research projects in universities and improve the project winning rate is a common problem faced by scientific research workers and scientific research managers\(^8\). This paper mainly analyzes and studies the application of Genetic Algorithms in project declaration management. Therefore, we need to do a feasibility analysis of this research. After confirming that research is feasible, we need to make an overall system design for project declaration so that future projects can be better implement declaration and management.

3.1. Feasibility Analysis
Feasibility analysis can also be called feasibility study. Through the main content and supporting conditions of the project, such as project scale, functional requirements, resource supply, fund raising, etc., research, analysis and comparison are carried out in terms of technology, economy, and engineering. Based on the research, it is determined whether the new plan is feasible to avoid investment mistakes, ensure the successful development of new projects, and can be predictable and reliable. We are ought to always pay attention to the trends, characteristics, and laws of the development of science and technology, observing, thinking, dealing with problems from the perspective of science technology development\(^9\). The feasibility analysis of this paper is mainly to analyze and study the algorithms.

As shown in Figure 1, we input project categories and declaration project indicators. In the intelligent detection system, the Genetic Algorithms to directly use the objective function as search information to operate on the coding of the parameters. Meanwhile we can use probabilistic search technology to flexibly increase the calculation speed through massively parallel calculations. Such characteristics, we use the Genetic Algorithms to calculate the project output of the project through the input value of the best output value is the optimal solution, and then compare the new input and the optimal solution to determine whether to pass the declaration. If the declaration is successful, the application result will be output at the end; if the application fails, it will be fed back to the scientific research personnel who will make changes and re-submit.

3.2 System Design
Project management principles can be defined as management and guidance of time, materials, manpower, and costs, complete specific projects in an orderly economic manner meanwhile achieve established goals in terms of time, cost, and technical outcomes\(^10\). This requires managers to implement system design in a comprehensive and up-to-date manner.

System design is the process of designing a new system that can satisfy the required goal to the maximum extent, based on the results of the system analysis, using system science ideas and methods. In the design of the system, the internal design and external design must be combined to reflect the principles. From the aspects of function, input, output, environment, program, human factors, and material media of the overall system, the system can be divided into several subsystems or elements. Decomposition can be carried out from the aspects of structural elements, function requirements, etc., and its characteristics and performance are standardized, integrated into an optimal subsystem, and then the overall design of the optimal subsystem is carried out to obtain an overall optimal system\(^11\).
In the university's scientific research management system, this part of the application project subsystem is particularly important. After a project is determined to be worth starting, it will be valuable and effective. As shown in Figure 2, In our project declaration system, include declaration forms, declaration indicators, query results, expert detection indicators, data analysis systems, and intelligent decision systems. The declaration form and declaration indicator belong to the data input stage. At this stage, the scientific research personnel input all the information of the project they want to declare into the system, then the expert detection system will use the monitored indicators to declare the various items of the project. The indicators are compared with the prescribed declaration indicators to obtain the data. After that, the data analysis system is used to analyze the above data. The intelligent decision system can judge whether to pass the declaration based on the analysis result, finally give the report result. There is a query result that can be used by researchers to check the results of the declaration.

4. Concrete Embodiment

Genetic Algorithms is often used to generate effective solutions to find the optimal solution and thus better solve the problem. It usually includes four steps: initialization, selection, crossover, and reorganization. In the selection stage, the fitness function is selected according to the requirements of the problem to be solved. The selection of the fitness function will affect the performance of the future system. If it is not properly chosen, it may converge to local optimum instead of ideal global optimum[12]. Once apply for a project, it need to initialize it that set parameters at first so that can be used as the initial group. The total number of the individuals is denoted by \(M\), the initial population is represented by \(P(0)\), the initial value of the evolution algebraic counter is set to \(t = 0\), the largest evolutionary algebra is \(T\). These are set for subsequent selection, crossover, and mutation. The offspring group will terminate the condition judgment when \(T = T\) is reached. When the maximum evolutionary algebra is reached, the optimal solution obtained is output which is initialized.

It is worth noting that the input of these parameters is not selected directly but for each individual to evaluation that to calculate the fitness of the individuals in the group \(P(t)\). At this moment, the degree of fitness is the individual's judgment of the size of the project's success relative to the performance of the project to be implemented. Then according the input parameters to choose. The selection algorithm is derived from the natural selection phenomenon of the survival of the fittest in biology, include roulette selection method, tournament selection method, random traverse selection method, and population-based communication selection method. In our study, the roulette selection method which is a kind of selection method first proposed in the genetic algorithm is mainly used. It is widely used mainly based on the selection method of probability. According to the individual fitness degree obtained by using the fitness function in the individual evaluation and large fitness are selected relatively. Those individuals are retained, low fitness are ignored, and the retained individual is taken as choosing an operator is equivalent to the possibility of a descendant's reservation. Based on this, when we make a selection, assuming a roulette dividing it into several parts that according to the percentages of individual's fitness level, the fitness is greater, the chance of being selected is bigger. When the roulette selection method is used, the number of this group is represented by \(M\), and the fitness of each individual factor that affects the success of the item is \(f(x_i)\), the probability of the individual selection is:

\[
P(x_i) = \frac{f(x_i)}{\sum_{j=1}^{M} f(x_j)}
\]  

The simulation process can generate a uniformly distributed random number \(r\) in \([0,1]\), from the
cumulative probability formula:

\[ q_i = \sum_{j=1}^{i} P(x_j) \]  

Calculate the cumulative probability of an individual and the cumulative probability of an individual \( x_i \) that affects the success of the project declaration. Compare the random number \( r \) with \( q_i \), if \( q_{i-1} < r \leq q_i \), select \( x_k \) (\( 2 \leq k \leq M \)). Individuals who have opted for optimization through the selection phase will use a large number of programming languages in the scientific research management platform. Then the technical support will become a relatively large factor affecting the success of the project, and the participant with relevant experience will also be important individuals for project success. Other highly-adapted individuals will also have a relatively large impact on the success of the project. Then we can combine these remaining individuals and select a few individuals to be retained during the combination. The combination adds the fitness of the combined individuals to obtain the added results. These results are crossover operators generated and some individuals of these are subject to change. For example, in a crossover operator, we can modify the staffing and the participants to those who have relevant experience so that the success rate of the project can be improved. After above steps, the group \( P(t) \) can be selected, crossed, and mutated to obtain the
offspring group \( P(t+1) \), then determine whether or not the maximum evolutionary generation \( T \) is reached, if \( t \neq T \) it will continue with the above steps, otherwise the individual is the greatest fitness obtained in the evolution process. Outputs these individuals as the optimal solution and then terminates the process of the Genetic Algorithms.

As a result, the intelligent inspection system of the project application subsystem is completed. When the project application personnel enters the relevant information of the project into the reporting subsystem every time, the intelligent inspection system will compare the declaration information that has entered with the optimal solution generated by the intelligent detection system to determine whether the declaration is successful and the declaration result is output to the applicant.

5. Conclusion
In the era of big data, the scientific research management information of university need to been managed will become increasingly huge, and traditional manual management methods cannot handle such huge data at all. Therefore, an optimal method of processing data is particularly important. This article mainly explains the use of Genetic Algorithms to solve the function of the project reporting subsystem in the university scientific research management system. Technically, the project application review process is implemented mainly through expert inspection systems, data analysis systems, and intelligent decision systems. The application of Genetic Algorithms can achieve the optimal solution, aiming to find the project with the highest success rate through the application.

Acknowledgment
The work presented in this paper was substantially supported by the National Science Foundation of China(Grant No: 61702370), Key Program of the Natural Science Foundation of Tianjin(Grant No. 18JCZDJC36300 ), the technology plan of Tianjin (Grant No: 14RCGFGX00847) and the Open Projects Program of National Laboratory of Pattern Recognition.

References
[1] Spencer J W. How relevant is university-based scientific research to private high-technology firms? A United States-Japan comparison[J]. Academy of Management Journal, 2001, 44(2):432-440.
[2] Kang L, University A A. The university scientific research information management system based on J2EE technology research[J]. Journal of Anshan Normal University, 2016.
[3] Meng Xianglin, Tian Jingfeng. Analysis of Student-oriented Scientific Research Work in Colleges and Universities[J]. China Electric Power Education, 2012,(25). 143-145.
[4] Holland, J.H. (1975) Adaptation in Natural and Artificial Systems, Ann Arbor, MI: The University of Michigan Press. 2nd edn. (1992) Boston, MA: MIT Press.
[5] Davis L. Handbook of genetic algorithms[J]. Handbook of Genetic Algorithms, 1991.
[6] Mitchell M. An Introduction to Genetic Algorithms[J]. Sadhana, 1999, 24(4-5):293-315.
[7] https://baike.baidu.com/item/%E9%81%97%E4%BC%A0%E7%AE%97%E6%B3%95/838140?f r=aladdin
[8] Yu Jianfei, Mao Weihua. Discussion on Quality Control of Scientific Research Projects in Universities under the New Situation[J]. Higher Agricultural Education,2004(02):40-42.
[9] Wen Qi,Lai Xiuyue,Fresh Qiao Wei. Some Thoughts on the Application of Scientific Research Projects in Universities[J]. Journal of Xihua University (Philosophy and Social Sciences),2005(02):50-51.
[10] Metcalfe B. Project management system design: A social and organisational analysis[J]. International Journal of Production Economics, 1997, 52(3):305-316.
[11] https://baike.baidu.com/item/%E7%B3%BB%E7%BB%9F%E8%AE%BE%E8%AE%A1
[12] Mccall J. Genetic algorithms for modelling and optimisation[J]. Journal of Computational & Applied Mathematics, 2005, 184(1):205-222.