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Hybrid Task Scheduling Algorithm Considering Game Model in Distributed System

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Abstract: The distributed system has the characteristics of small scale, strong dynamics, and has an impact on both supply and demand. It plays a very important role in solving complex problems. In this paper, a mathematical model of hybrid task scheduling algorithm is established based on the consideration of profit maximization and uncertainty constraints in cooperative game among enterprises. Firstly, this paper studies the hybrid scheduling problem, then introduces the game model, and then studies the application of hybrid task scheduling algorithm. On this basis, the structure of distributed system is designed and the model is tested. Finally, the test results are shown. Under the optimization of hybrid task scheduling algorithm, the distributed system has improved the worst result and stability to a certain extent, and the improvement degree is great. The improvement effect of load balance degree is obvious and the stability is higher.

1. Introduction

The dynamic and complexity of distributed system makes it widely used in real life. However, the traditional optimal strategy is to transform the stochastic programming problem into a single state, ignoring other uncertain factors [1-2]. Therefore, in order to solve this thorny and complex problem, which is characterized by diversity of decision-making and large amount of information, the dynamic evolutionary game model of non cooperative systems with the largest defect of solution (i.e., many constraints and disorder) is widely used in distributed systems to solve this incomplete resource allocation problem [3-4].

Many scholars have studied the game model. Among them, Britain, the United States and other countries have developed and applied the theoretical model to solve practical problems to a certain extent. In recent years, with the continuous change of the international economic environment and the acceleration of the process of information socialization affecting the production and operation activities of enterprises involving multiple decision makers, it is considered that the number

understanding method in the game needs to meet some conditions in the solution process to obtain the optimal results [5-6]. Some scholars have studied the game model. He pointed out that if the constraint conditions are not set to zero or equal to zero, the solution is not optimal. If the lowest point of marginal cost is the maximum feasible region, the minimum weight method must be used to solve the problem. However, there are often many decision-making and non planning situations in practical problems. Other scholars have found through analysis that it can be regarded as the maximization and minimization solution to obtain the best results through game calculation. When solving environmental problems, they use the enterprise optimal solution strategy in the distributed system to solve complex function optimization problems that cannot be handled by traditional methods [7-8]. Therefore, considering the game model, this paper studies the application of hybrid task scheduling algorithm in distributed systems.

In the distributed system, the enterprises participating in the game are dispersed, and their information is infinite and uncertain. So we can solve this problem by using heuristic function in operational research. This paper mainly introduces two aspects of considering constraint conditions and non negative matrix optimization criteria, and introduces genetic algorithm to solve the task scheduling model of hybrid system. Finally, the theoretical analysis results are compared with the simulation results through an example to verify the feasibility and reliability of the algorithm in practical application, and provide a method of reference value for decision makers.

2. Discussion of Hybrid Task Scheduling Algorithm Considering Game Model in Distributed System

2.1. Hybrid Scheduling Problem

In distributed systems, scheduling problem is a complex nonlinear programming. It involves many mathematical methods, including game theory, mathematical statistics and decision analysis. These theories and technologies can be used as tools or means to solve this kind of problems. However, since they are all solved randomly and not by a constant value matrix to achieve the optimal solution or a hybrid optimization algorithm to obtain the best global minimization effect, there are many difficulties in dealing with this complex system. It is determined that the problem itself is a single objective mathematical programming model [9-10]. In a distributed system, the scheduling problem is the optimal solution under certain constraints. It not only includes two types of optimal decision and optimal decision, but also includes the comprehensive functions of maximizing the expected utility function, minimizing the social welfare and other objectives, encouraging and constraining the enterprise, as well as punitive constraints, to improve the system operation efficiency and quality. However, in the actual situation, there are often various uncertain factors that affect the scheduling problem in the distributed system, and these uncertain factors will also bring some errors to the solution, and even lead to serious errors in the solution. In distributed systems, there are many problems that can be converted into mixed optimal solutions. For example, we regard the solution as a set of two single objective functions, but not all cases can be considered. Therefore, it is thought to minimize a model with good dynamic behavior ability and static decision probability (i.e., particle swarm optimization), which is also called two-step model. Figure 1 is a flow chart of a task scheduling model.

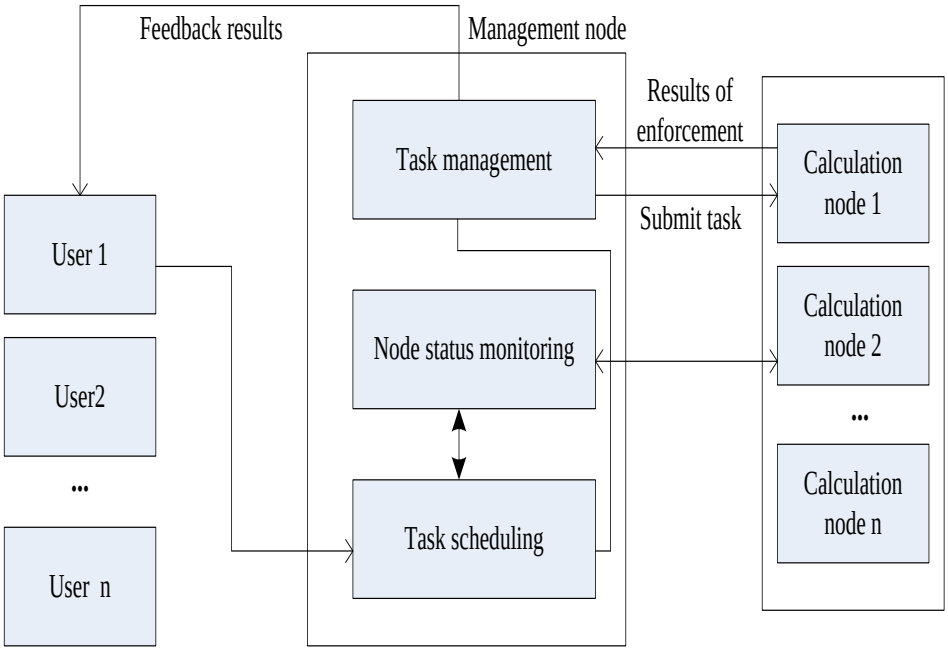
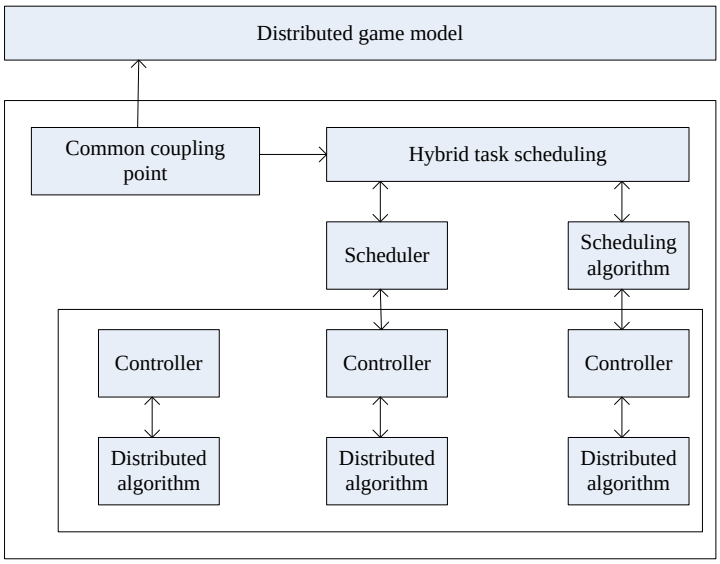


Figure 1. Task scheduling model process

2.2. Game Model

In the game theory, we compare the two sides of cooperation. If one side can get the efforts and benefits that the other side needs to pay and can do more, the other side will make a strategy that is beneficial to the other side to get more benefits or minimize its own optimal profit. In practical problems, it is usually assumed that it is unfair for two individuals to only consider their own situation, that is, the equilibrium state in the game theory. When both parties can benefit from the game theory, the strategic choice between the decision-maker and the cooperative enterprise is interdependent and mutually beneficial. This is the so-called benefit sharing. However, for the traditional allocable problem, if we solve it for the purpose of obtaining the maximum profit when participating in the competition, the gain outweighs the loss. However, considering the factors of each participant and the overall situation of the whole system to determine the optimal strategy, it is not a simple and linear programming problem. In game theory, there will be a certain degree of "Nash equilibrium" between the resources and demands held by each subject. In game theory, every enterprise is an independent individual, and they compete and cooperate with each other. However, each node participating in the game will have its own relatively optimal strategy. What we are studying is how to make the optimal combination of these optimal solutions (i.e., maximize their own interests) most effectively distributed to various enterprises to achieve the goal of profit maximization. The first aspect is to generate the lowest or most favorable resource allocation for other participants through analyzing the interaction between various elements within the system, so as to make the whole supply chain obtain the best efficiency and the highest profit [11-12]. Figure 2 is a game model diagram in a distributed system.



Figrue 2. Game models in distributed systems

2.3. Hybrid Task Scheduling Algorithm

In this paper, we mainly introduce the problem of task assignment in distributed systems. Because distributed system is a multi-objective optimization algorithm. It regards multiple decision points as a whole, and each individual can make the optimal selection of the game strategy of the next generation to be executed by himself. Moreover, the solutions of these participants are obtained after the solution to decide whether to continue or stop the operation and other processes, so as to maximize or minimize the overall decision-making, thus optimizing the overall benefit of the system and maximizing the global search ability [13-14]. In a distributed system, each task has to go through multiple decisions, and each scheme is composed of several non cooperative individuals, and also has an independent objective function. We call these problems with mixed properties mixed model scheduling. Traditional game theory believes that participation in decision-making and personal actions are interdependent, and there are characteristics such as sequencing and reciprocity between them [15-16]. In practice, it is impossible to make the optimal policy selection under the condition of complete rationalization, randomization or full information sharing. Therefore, this paper proposes a priority calculation method based on data input (in data) and data output (out data) of tasks, which is called in level value (IL) and out level value (OL) respectively, and the sum of the two is called in out level value (IOL). Therefore, the in level value, out level value and in out level value of task Ti are calculated as follows:

$$IL(T_i) = \sum_{T_{pred}(T)} C(T_i, T_j) \tag{1}$$

$$OL(T) = \sum_{T_{Succ}(T)} C(T_i, T_j) \tag{2}$$

The in level value of the task Ti reflects the amount of data required by the task Ti, and also indicates the degree of influence of the scheduling of TI's predecessor tasks on the scheduling of the task ti. The out level value of task Ti reflects the amount of data that ti's successor task needs to provide, and also indicates the impact of task ti's scheduling on the scheduling of its successor tasks.

Therefore, the method of determining the priority based on the in level value and the out level value is not to optimize the scheduling of the current single task, but to ensure the optimal scheduling of the subsequent tasks of the current task [17-18].

3. The Experimental Process of Hybrid Task Scheduling Algorithm Considering Game Model in Distributed System

3.1. Structure of Distributed System

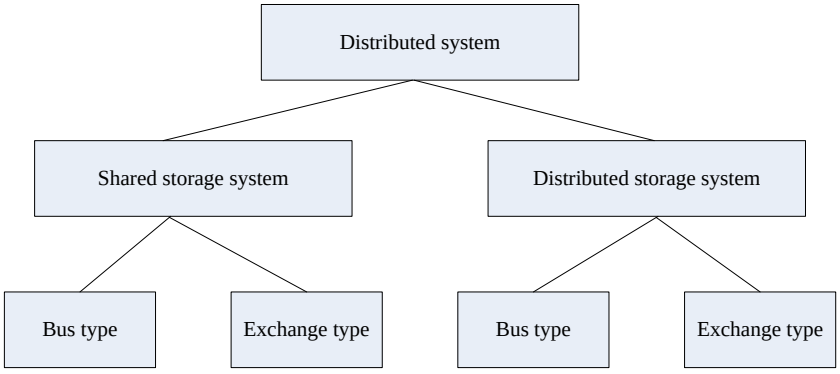


Figure 3. Distributed system structure

A distributed system is generally composed of one or more nodes with similar attributes. Each point is equivalently connected to each other to a certain extent and can form a random space. These adjacent nodes are independent of each other and can perform random switching, as shown in Fig. 3. Integer programming is the most widely used distributed problem. In this case, we call it "number" type and N or 2 constraints, and the attribute set of the objective function represented by X is obtained from a linear matrix. A distributed system is generally randomly selected from a given rule, and these selected rules are called distributed models. It can make the optimal decision for any one or more uncertain factors. At the same time, this method has its limitations: it is greatly affected by many aspects such as constraints, scale and parameters. In addition, there are many disadvantages, such as making estimation and prediction more difficult. After considering the above situation, the distributed system planning is a representative and random behavior dependent set of autocorrelation multi-attribute policies, which is widely used in practice.

3.2. Performance Test of Hybrid Task Scheduling Algorithm in Distributed System

In order to test whether it can effectively solve practical problems, we fully consider the constraints and tasks, and treat them as decision variables in the mixed model. Here, the effectiveness of the strategy is mainly verified by simulation experiments. Firstly, a scenario is selected. Because of the complexity of the distributed system, the model parameters are difficult to determine and the optimal solution cannot be directly measured. Secondly, multiple objective functions and different locations are selected for combined scheduling (i.e., under different locations) to obtain better effects and better performance. Finally, the schemes are sorted and the mixed model results are finally obtained. In the distributed system, the dispatcher is responsible for the task execution, and also controls the resource allocation and demand output of the enterprise. However, it is difficult for managers to make the best choice based on these multi-attribute factors

because of various complex relationships among multiple decision-makers and information constraints from various aspects. Taking into account the game model can effectively solve this problem, deciding which activities are initiated by who according to multiple decision makers, scheduling tasks after each participant issues instructions, and then executing control variables and making corresponding operations to maximize benefits and accuracy.

4. Experimental Analysis of Hybrid Task Scheduling Algorithm Considering Game Model in Distributed System

4.1. Performance Test and Analysis of Hybrid Task Scheduling Algorithm

Table 1 shows the performance data of the hybrid task scheduling algorithm considering the game model in the distributed system.

Table 1. Mixed-task scheduling algorithm

Test item	Schedule length	Improve the effect(%)	Load balance	Improve the effect(%)
The optimal results	36748	88	98	89
The worst result	35562	87	85	88
Average value	35641	90	94	84
Stability	37534	87	95	86

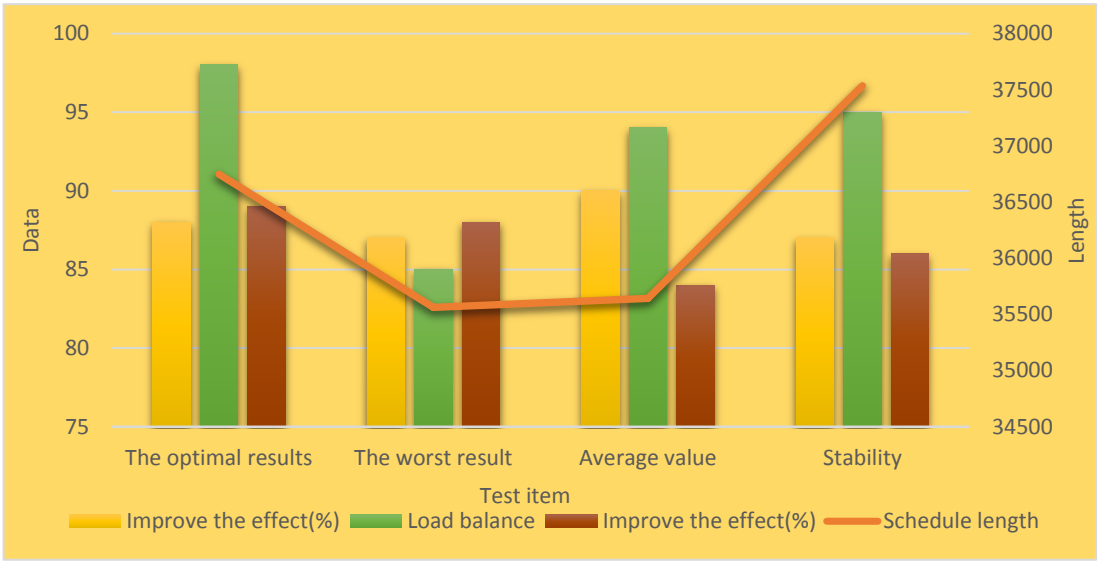


Figure 4. Performance testing

As a non constrained programming problem, tasks in distributed systems have better performance in solving complex and uncertain problems such as dynamic decision-making, resource optimization scheduling and environmental performance. Considering the advantages and disadvantages between the distributed system and the traditional solution method, and because the model itself needs a certain number and quality eigenvalues to describe the actual situation, the

model has high sensitivity to parameters and low requirements for algorithm. It can be seen from Figure 4 that under the optimization of the hybrid task scheduling algorithm, the distributed system has improved the worst result and stability to a certain extent, and the degree of improvement is great. The improvement effect of load balance degree is obvious and the stability is higher.

5. Conclusion

With the development of distributed system, it plays a very important role in many fields such as economy, science and technology. This paper is based on the knowledge management and decision support vector machine theory and the comprehensive optimal solution principle. Through the analysis, it is found that the enterprise benefit can be maximized when considering the constraint conditions. Considering the information gain effect, we can get the maximum profit, while ignoring the influence of enterprise scale, we can get higher profit. This shows that distributed system has a great prospect in solving multi-objective problems.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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