Consumer behavior algorithm for cloud computing based on ant colony optimization algorithm

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Abstract—In the current and social market economy of our country, cloud computing is gradually get better development. However, there is no charges related to cloud computing, cost directly affects the resource utilization of enterprises and satisfaction of users. Load the network situation of the ant colony algorithm to simulate the operation of the network, but to solve the balance and traffic load of the network congestion is incapable of action. For the above problems, the author puts forward an improved ant colony algorithm, the relevant data for consumer behavior in the use of ant colony algorithm, scheduling, use of consumer behavior to help to solve the problem of network load, so as to achieve the goal of rational use of cyber source. The improved algorithm mentioned in this article, on-time performance is better than the ant colony algorithm. Meanwhile, the authors introduced a consumer preference factor, making scheduling more flexible cloud computing and intelligent. In addition to the authors propose a new model that can help users more involved in the cloud were to go, so to find a maximization of their own interests.

Keywords-consumer preference; cloud computing;ant colony algorithm;consumer behavior; customer satisfaction

I. INTRODUCTION

With the rapid development of technology, the demand of information and data for modern society increases rapaidly. Meanwhile, the demand for fast calculations is increasing urgently. To conserve resources and costs, and to improve the scalability of the system, the concept of cloud computing generates. Cloud computing is a new method of calculation that based on the Internet, through this way, the hardware resources and information resources that shared by workstations can be provided to other devices in accordance with the requirements. When using cloud computing services, users do not need to understand the working principles of cloud computing, simply submit your own tasks and pay the appropriate fee for the use of cloud computing services. Cloud computing has a good view of the prospects. So today's major IT companies have launched their own cloud computing services, such as Google, Microsoft, Hewlett-Packard, Intel, IBM, Dell, AMD. For cloud computing providers ,they most concerned about how deal with computing and effective management so that resources can be allocated rationally and user satisfaction will be improved. Therefore, the efficiency of cloud computing directly affect the company's own interests and user satisfaction. Thus, it's important to find a reasonable way to deal with tasks imminent.

II. ANT COLONY ALGORITHM

Ant colony algorithm was first put forward by the Italian scholar Dorigo, he analyzed the behavior about foraging of ants and proposed this intelligent algorithm. When ants go out for food,they can release a pheromone on the way, and the other ants can feel the concentration of this substance, so they can move towards the place where has the highest concentration.So the phenomenon feedback appeared because of a large number of ants foraging together.

Dorigo according to this phenomenon to establish ant colony algorithm model,and achieve the approximate solution[1] of TSP(Traveling Salesman problem) by computer simulation technology.Subsequently,the ant colony algorithm is used to solve the problems of resource allocation, production scheduling,task assignment and NP[2-5].Results showed that ant colony algorithm can achieve better optimization solution for solving complex problems.

However,the ant colony algorithm also has some problems,such as local concergence and speed of local convergence.Some scholars put forward many improved measures,and mainly concentrated in three aspects:first,limit variation range of pheromone;second,enhance feedback mechanism;third,through enhance search ability of algorithm and set reasonable parameters of algorithm.Literature[1] uses variable function Q(t) to instead of parameter Q of AS algorithm,and this avoid local optimal solution.Literature[4] proposed an adaptive strategy to avoid algoritm stuck in a standstill. Literature[7] increased pheromone concentration of optimal path,and this improve feedback and improve the convergence rate of the algorithm.Literature[8] by introducint the mutationoperator to avoid stagnation phenomenon.Literature[9] using auantum principle to improve the ant colony algorithm 's global search capability.

In order to make the ant colony algorithm more remarkable, scholars put forward many improved algorithms. Such as improved quantum ant colony algorithm based on bloch coordinates[10-11];robot coalition problem based on novel quantum-inspired ant colony algorithm[12];a novel quantum ant colony algorithm for the choice for the site of the urban poublic transport station problem[13];quantum ant colony algorithm-based emergency evacuation path choice algorithm[14];calculation and analysis of electromagnetic in an induction motor based on continuous quantum ant colony optimization[15];a novel ant colony algorithm of solving nonlinear equation group[16]; However, in actual operation, the improved algorithm will tend to fall into local optimal solution, and its accuracy and its precision and the convergence speed are need to be improved. And in actual operation, some nodes may suddenly fail when there are some probables. So it is necessary to propose a new improved algorithm.

The algorithm model is as follows.

$$p_{ij}^{k}(t) = \begin{cases} 0, & j \notin J_k(i) \\ \dfrac{[\tau_{ij}(t)]^{\alpha}[\eta_{ij}(t)]^{\beta}}{\sum_{s \in J_k(i)} [\tau_{is}(t)]^{\alpha}[\eta_{is}(t)]^{\beta}}, & j \in J_k(i) \end{cases} \quad (1)$$

$p_{ij}^{k}(t)$ represents probability about ant k from node i to node j at moment t. $J_k(i)$ represents avaliable node for ant k at moment t. $\tau_{ij}(t)$ represents pheromone concentration between node i and node j at moment t. $\eta_{ij}(t)$ is the heuristic factor at moment t,represents the expected value about ant from i to j.。α,β represetns the relative importance degree about pheromone and heuristic factor.Over time,the pheromone in path update according to the following formula.

$$\tau_{ij}(t+1) = (1-\rho)\tau_{ij}(t) + \Delta\tau_{ij} \quad (2)$$

ρ represents the decay degree about pheromone as time goes.the increment about pheromone can represent as follows:

$$\Delta\tau_{ij} = \sum_{k=1}^{m} \Delta\tau_{ij}^{k} \quad (3)$$

m represents the number of ants.

To the general ant-cycle model:

$$\Delta\tau_{ij} = \begin{cases} Q/L_k, & \textit{if ant k after path} \\ 0, & \textit{otherwise} \end{cases} \quad (4)$$

Q represetns the information strength,, L_k represents the tatal length that ant k passed in this cycle.

III. CONSUMER BEHAVIOR AND CONSUMER BUDGET EQUATOION

A. Consumer Behavior

Consumer behavior is a economic behavior refers to people in order to meet their needs,that is,people's purchase decision and buying behavior in the market.

Premise of consumer behavior

(1)the maximize of desire to meet and consumer surplus

(2) the consumer's information is correct and complete

(3) the consumers' incomes established.

(4)the consumer preferences established. Each consumer has a preference for the type.

(5) respecting consumer sovereignty.

(6) commodity price established.

Based on the above six kinds of factors, we can know that consumers often have their own preferences, and they are trying to pursue the greatest consumer surplus. Therefore, cloud computing service providers can offer users more rights to self-selection. In this way, it is good for both users and service providers. Fig.1 is the flow chart for this model:

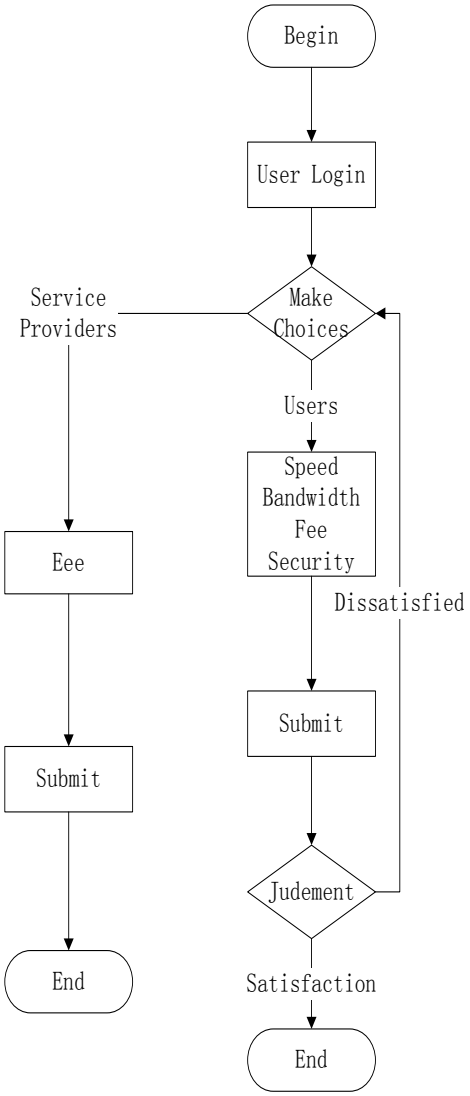

Figure 1. Customers' stategies model

From the figure above we can know that when the user logined in the system, the task can be submitted directly to their service provider.Users only need to pay the appropriate fees, and service providers will be scheduled to run their programs. On the other hand, users can also choose to adjust the parameters of their own, choose the

appropriate combination. When the final submission combinations can also re-discovered dissatisfied selection strategy and the corresponding parameters.

B. Consumer budget equation

Assuming there are n kinds of goods available for consumers to choose,and their prices are P1,P2,...Pn. They can be represented by a vector

$$\vec{p} = (p_1, p_2, ..., p_n),$$

P_i represents the price of goods i.The money for consumers to buy goods called consumers's budget. combination of goods that consumers purchased can represent by a vectory $\vec{Q} = (Q_1, Q_2, ..., Q_n)$.

Q_i represents the amount of goods that consumer purchased.According consumers's budgets,we can know that:

$$\vec{P} \bullet \vec{Q} = \mathrm{M} \quad (5)$$

$$P_1Q_1 + P_2Q_2 + \cdots + P_nQ_n = M \quad (6)$$

In cloud computing, the quality of services that services providers provide to the customers involved bandwidth, speed, cost, and security. And users are willing to pay for cloud computing costs are generally fixed. Therefore,based on the consumer budget equation, we can have the following formula:

$$WQ_1 + S_dQ_2 + S_fQ_3 = M \quad (7)$$

W represents bandwidth costs of per unit，S_d represetns speed costs of per unit, S_f represents security costs of per unit. Q1、Q2、Q3 represents the quality of services.

IV. ANALYSIS OF THE PROGRAMMING MODEL IN CLOUD COMPUTING

The current cloud computings are mostly use distributed computing called Map Reduce of Google,and it can automatically divided task into multiple sub-tasks.Through by two-steps of Map and Reduc,it can make tasks schedule and allocate in large-scale computing nodes.Most IT vendors raised Programming models of cloud,and these models are mostly based on the open idea of Map Reduce. Map Reduce is particularly suitable for the production and processing of large data set. Its implementation process shown in Fig.2.

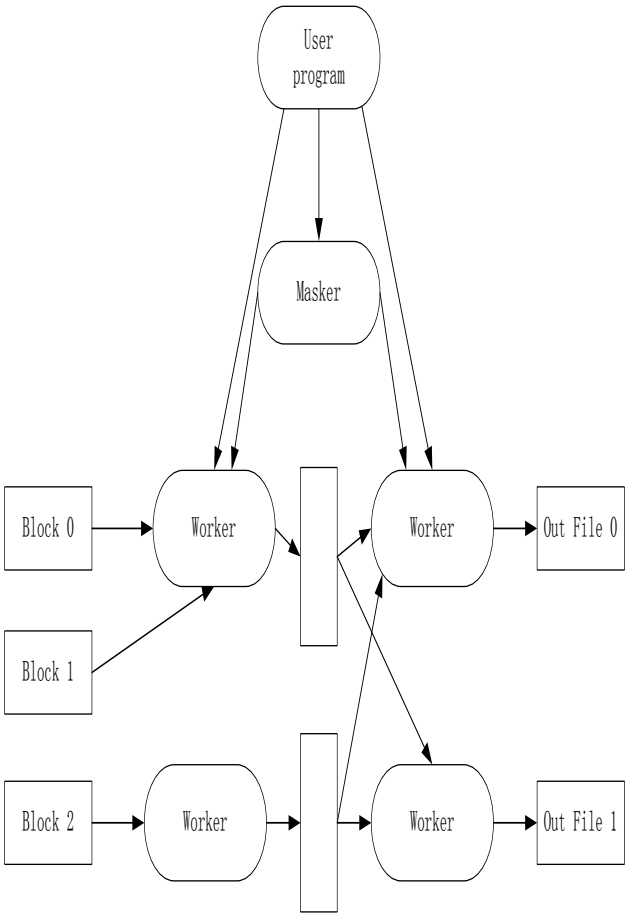

Figure 2. The specific implementation process of MapReduce

As can be seen from Fig.1, MapReduce can be separated in two main stages:

(1) Map phase:make a larger task in to M pieces through Map Reduce library in users' programs,and the size of each piece is 16 ~ 64 MB.Then allocate each pieces to worker to execute and output data file.

(2) Reduce phase: analyse the results of the Map stage,and output the processed result.How to schedule numbers of sub-tasks in the programming model of MapReduce is a complex problem. Each task is divided into M pieces of stage of Map and R pieces of stage Reduce. M and R should be more compared with worker machines,and each worker may perform many different tasks.

V. CONSUMER BEHAVIOR ALGORITHMS FOR CLOUD COMPUTING

In real life, the process for pursuit utility maximize is the adjustment process of choice behaviors of consumers. When selecting goods and services, the basic motitation of consumers' come from a rational choice to make the consumer's utility maximize. With the realization of the utility maximization, the motivation for pursuiting utility maximization will stop. At the same time, the motivation for adjusting stopped, consumer equilibrium will be achieved. Similarly, when buying cloud computing services, rational consumers will choose to make their own strategic to make utility maximization. Therefore, providers of cloud computing services can allow consumers choose strategy by themselves. As consumers

have their own consciousness, so their selection is dynamic, and it is better than the static algorithm. Therefore, we can capture their choice based on consumer behavior data, thus making them into the ant colony algorithm, which can solve the problem of local optimum solution.

$$p_{ij}^{k}(t)=\begin{cases}0, & j\notin J_k(i)\\ \dfrac{[\tau_{ij}(t)]^{\alpha}[\omega_{ij}(t)]^{\beta}}{\sum_{s\in J_k(i)}[\tau_{is}(t)]^{\alpha}[\omega_{is}(t)]^{\beta}}, & j\in J_k(i)\end{cases} \quad (8)$$

其中：

$$\omega_{ij}(t)=\frac{A_e}{A_i+A_j}; \qquad j\in J_k(i) \quad (9)$$

$\omega_{ij}(t)$ represents the expected value of server i visits next server j at moment t, A_i and A_j represents the load value of server i and next server j. A_e represents consumers's strategy valu. The consumer policy values comes from the user in the choice of bandwidth, cost, speed, safety comes integrated value。

VI. THE SIMULATION AND ANALYSIS

In order to test the merits of the algorithm, we use the GridSim simulation environment to simulate the scheduling process. GridSim is developed by Australian scholar BUYYA R with a common grid simulator.

In the simulation experiments, we designed a grid environment that containing 12 resources and 12 task queue.Each of the task number is 20-120, the length of each task is 2000-7000. Then we compared the improved algorithm and ant colony algorithm.

The results are shown in Fig.2. We can know that at the same resources, the more tasks the longer time that is needed. However, under the same circumstances, the improved algorithm is better than ant colony algorithm.

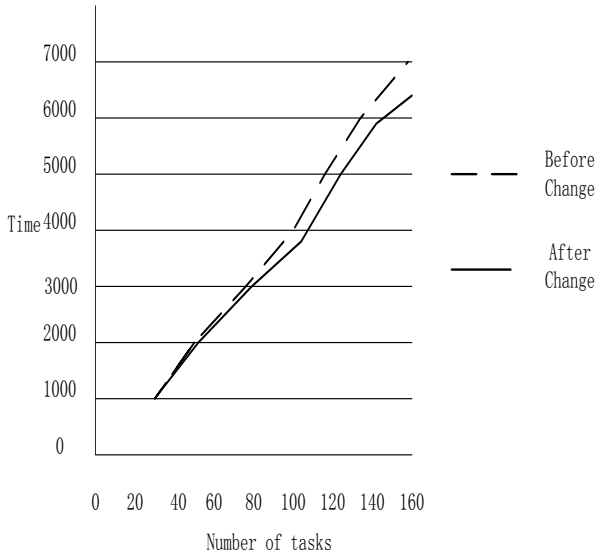

Figure 3. Test result

From the figure above we can know that the improved algorithm mentioned in this article is better than the ant for using little time. The improved algorithm solves the local optimum defects about ant colony effectively and improve the search performance.

VII. CONCLUSION

In this paper, we based on ant colony algorithm and combined with the theory of consumer behavior, making improvement about ant colony algorithm.Improved algorithm helps solve the problem of overloading about the local network. Meanwhile, the authors introduced a consumer preference factor, making scheduling more flexible cloud computing and intelligent. It plays a certain role for consumers and service providers.In addition,the authors propose a new model that can help users more involved in the cloud, so to find a maximization of their own interests.

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