Intelligent Course Scheduling Method of Single Chip Microcomputer Application Technology Based on Reinforcement Learning

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Abstract. Considering that the single-chip microcomputer application technology course involves both theoretical and practical courses, and the single intelligent course scheduling method is only for theoretical or practical courses, the course scheduling time is long, and the course scheduling effect is reduced. Therefore, an intelligent course scheduling method based on reinforcement learning is designed. Collect the course scheduling data of single chip microcomputer application technology; Design intelligent course scheduling database based on reinforcement learning; Then realize the intelligent Course Scheduling of single chip microcomputer application technology. By means of comparative experiment, it is verified that the new method has shorter course scheduling time, better course scheduling effect and great promotion value.

Keywords: Reinforcement learning · MCU application technology · Intelligent course scheduling · Course database

1 Introduction

At present, with the great impact of the wave of informatization, coupled with the vigorous development of intelligent network, with the doubling of the enrollment scale index of colleges and universities, the enrollment rate of colleges and universities suddenly burst, and the course contents and teaching plans set up by colleges and universities continue to develop in the direction of depth and breadth. It is precisely because teachers, teaching space and teaching equipment can not meet the actual teaching requirements of colleges and universities, This makes the past educational administration course scheduling management methods far from meeting the needs of course scheduling in Colleges and universities, and pays attention to the occupation ratio of educational administration resources [1]. Due to the relative shortage of teachers, teaching space and teaching equipment, course scheduling in Colleges and universities is very difficult in educational administration management, and the workload of educational administration course scheduling is amazing, and the effect of course scheduling is not intelligent enough. How to arrange teaching resources with high utilization rate on the curriculum of colleges and universities, so as to solve the problem of curriculum arrangement of

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educational administration in Colleges and universities [2]. In order to realize the full management of educational administration resources and ensure the teaching quality and educational administration management, colleges and universities urgently need to formulate a reasonable curriculum arrangement. Since the development of colleges and universities for many years, curriculum arrangement has become a new generation of academic research topic, and has also achieved many theoretical achievements and practical benefits. Therefore, with the help of intelligent course scheduling method to assist college educational administration course scheduling has become an intelligent means to solve the shortage of teaching resources. In order to ensure the high utilization of teaching quality and teaching resources in Colleges and universities, it is an urgent problem to formulate a scientific and reasonable teaching plan for the management of educational administration in Colleges and universities.

As the most complex and key part of the management of the academic affairs office, the course scheduling task in Colleges and universities has become the research object of this paper [3]. However, in solving the task of course scheduling in Colleges and universities, the waste of teaching resources and the conflict of course scheduling constraints still haunt researchers. The intelligent Course Scheduling in Colleges and universities is a linear programming problem that belongs to the combination of multiple constraints. The optimal setting of course scheduling comes from the competition between teachers who do not waste teaching resources and conflict with each other in the process of course arrangement, This is the most basic constraint on Course Scheduling in Colleges and universities [4].

Based on the above research, this paper puts forward an intelligent course scheduling method of SCM application technology based on reinforcement learning. By using the characteristics of computer technology, such as automatic processing, fast server response, accurate intelligent course scheduling constraints, and the pre-set constraints, the optimal course scheduling can be carried out. It solves the problems of huge workload and manual course arrangement, and improves the effect of course arrangement.

2 Intelligent Course Arrangement Method of Single Chip Microcomputer Application Technology based on Enhanced Learning

2.1 Collect Course Scheduling Data of Single Chip Microcomputer Application Technology

The core part of the intelligent course scheduling management method in Colleges and universities is to solve the problem of course scheduling. Course scheduling refers to the planning problem that combines the five in one of teachers, classrooms, courses, time and students to obtain the final solution. In essence, it is a nonlinear, constrained, multi-objective optimization and space-time combination planning problem, based on a certain course scheduling algorithm, The process of compiling and arranging the timetable with certain constraints, such as the mutual restriction and influence of various factors such as objective material conditions, educational administration organization composition and planning and solving objectives. The use of computer intelligent course arrangement is

a basic requirement that can avoid the restriction conflict between the five. The goal of intelligent course scheduling is to make full use of college teaching resources and obtain the best teaching effect under the premise of course scheduling demand constraints [5]. The intelligent course scheduling method in Colleges and universities enables the academic affairs office to automatically generate a complete course schedule in a short time according to the set constraints, so as to make the course scheduling work methodological, intelligent, standardized and automatic, and effectively improve the office efficiency of the academic affairs office. The methods of intelligent course arrangement in Colleges and universities include educational administration management, course schedule arrangement, information input, method management and online course selection. The implementation of course scheduling method is difficult.

The intelligent and automatic course arrangement management method in Colleges and universities designed in this paper is based on computer network to realize the analysis of all functional requirements for daily office, educational administration management and course arrangement management in Colleges and universities. According to the educational administration management and actual teaching needs of colleges and universities and the different teaching characteristics of each college, the intelligent course scheduling method sets the management requirements for different users to use different permissions, which are mainly set as the following roles: Super administrator, educational administration supervisor, educational administration course scheduling salesman, College Teachers and general users Multi level permission management architecture. The intelligent course scheduling method uses hierarchical authorization management mode and client click response access rights to ensure the reliability and security of the data of the intelligent course scheduling method.

Therefore, the development of intelligent course scheduling management method in Colleges and universities should follow the following requirements: try to use the development scheme with high software and hardware environment configuration, so as to achieve the intelligent course scheduling method with fast response speed and user satisfaction [6]. The intelligent management method can be continuously expanded, can access each other with other educational administration management methods, and the database design has good universality. Modular design method, unit writing module functions, and finally integrate the functions of each module, which is not only convenient for the optimal combination of course scheduling, but also convenient for later debugging, modification and maintenance. Data backup function, timely backup data according to actual needs. Therefore, the course scheduling problem is restricted by two constraints: basic constraint and fuzzy constraint. Among them, the basic constraint is the main body, and the fuzzy constraint is the secondary constraint. In the process of intelligent course scheduling, the basic constraint is the constraint principle that must be followed. However, the fuzzy constraint is to support the fuzzy principle as much as possible on the premise of meeting the basic constraints.

In terms of the main functions of the intelligent course scheduling method, according to the course scheduling business requirements, the investigation and research results of the current college course scheduling show that, on the basis of taking into account the requirements for future scalability and maintainability, the college intelligent course scheduling management system is given with five functional modules, The functions that

should be included are: Course Scheduling Management: the change module is mainly to realize the functions of user registration, login and basic modification. The super administrator sets the use rights of users in the system and other functional requirements of system settings [7]. Intelligent course scheduling method management completes the basic data management function; It mainly realizes the input function of the basic information of the system, and inputs the teacher information, student information, course information, class information and time period information into the database. Basic information module setting function: it mainly sets teachers, students, classrooms, resources, courses, divided time periods, etc. these basic settings must be preset before intelligent course scheduling. The course scheduling administrator maintains the set basic information; Setting of course scheduling constraints: this function mainly completes the arrangement of course schedule in Colleges and universities. Its function refers to the planning problem that combines the five elements of teachers, classrooms, courses, time and students to obtain the final solution. Automatic Course Scheduling Management: the course scheduling information management is responsible for the input management of the basic information required for automatic course scheduling; Course schedule management: this function realizes the management of course schedule, including automatic generation of course schedule, printing and output of course schedule, course schedule query function, and publishing the generated course schedule approved by leaders. The curriculum output can export the excel file type according to a certain format to form a curriculum that can automatically and intelligently arrange the first version of the curriculum or a modified curriculum.

2.2 Design Intelligent Course Scheduling Database Based on Reinforcement Learning

Reinforcement learning is an unsupervised learning method. It can find the strategies that can get the maximum reward by getting rewards and punishments from the environment. The biggest feature of reinforcement learning is the use of trial and error search and delayed reward and punishment. The so-called trial and error method, that is, "eating a moat and learning a wisdom", refers to constantly using the existing knowledge to try various actions, and correcting their own knowledge from the environment to reward and punishment, so as to correct their strategies. The so-called delayed reward and punishment is to convert and allocate the obtained reward and punishment to each action. When a decision-making process consists of a series of actions, each action makes a certain contribution to the final success and bears a certain responsibility for the final failure [8, 9]. Only by reasonably allocating the final rewards and punishments to each action can we learn the correct decision. Reinforcement learning refers to a class of algorithms with the characteristics of trial and error search and delayed reward and punishment. These include dynamic programming, Monte Carlo method, Q-learning, etc. The reinforcement learning algorithm is described below with symbols.

Consider such an agent. The agent has some sensors that can observe the state of its environment and make a set of actions to change these states. The task of learning is to obtain a control strategy to select the behavior that can achieve the goal. Here, it is assumed that the goal of the agent can be defined as a return function, which gives a digital value to the agent to select different actions from different states, which is called

immediate return. The task of the agent is to execute a series of actions, observe their consequences, and then learn the control strategy. The control strategy in this paper is to select the appropriate actions from the initial state of the task, so as to maximize the cumulative return of the agent over time. The general framework of this agent learning problem is shown in Fig. 1.

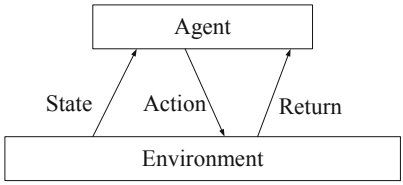

Fig. 1. An agent interacting with the environment

As shown in Fig. 1, the problem of learning control strategy to maximize cumulative return is a problem of controlling sequence process through learning. For example: production optimization problem, in which a series of production actions should be selected to maximize the value of goods minus their cost. The problem of learning control strategies to select actions is similar to the function approximation problem to some extent. Therefore, this paper uses reinforcement learning to design the intelligent course arrangement method of single chip microcomputer application technology. Given the course scheduling strategy x and set the course scheduling status to m, the intelligent course scheduling optimization strategy is as follows:

$$x' = \arg\max V(m) \tag{1}$$

In formula (1), x' is the intelligent course scheduling optimization strategy; $V(m)$ is the scheduling speed; $\arg\max V(m)$ is the course scheduling speed after intelligent optimization. To illustrate these concepts, a simple lattice environment is used to demonstrate them. As shown in Fig. 2.

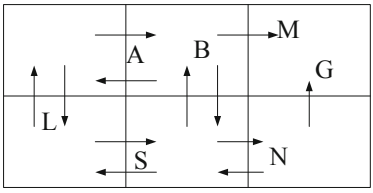

Fig. 2. Immediate return value

As shown in Fig. 2, the six squares represent six possible states of the agent. Each arrow in the figure represents the action that the agent may take to move from one state to another. The number on each arrow indicates the immediate return L that the agent can receive if it performs the action. For the convenience of discussion, a target state G is set in this paper. In this environment, once the agent enters state G, its optional action

can only stay in that state. Status, action and immediate return are defined in this paper. Here, A = 0.9 is selected. Through calculation, this paper quickly obtains an optimal strategy, which exactly specifies an action that the agent should choose in any given state, and guides the state G with the shortest path. In s state, the value function of the optimal strategy is as follows:

$$x'(S) = \arg\max[r(L, A) + \gamma(V(m), S)] \tag{2}$$

In formula (2), $x'(S)$ is the optimal course scheduling strategy under S state; $r(L, A)$ is the optimal path of L and A; $\gamma(V(m), S)$ is the optimal path of $V(m)$ and S. This paper introduces Q function and obtains:

$$Q(L, A) = r(L, A) + \gamma(V(m), S) \tag{3}$$

In formula (3), $Q(L, A)$ is the optimal course scheduling strategy after executing the immediate return value of A under the condition of Q value. Thus, the intelligent course scheduling database is shown in Table 1.

Table 1. Intelligent course scheduling database

Field name	Explain	Type	Is it empty
course_ID	Name	Varchar	Yes
course_name	Full name	Varchar	No
course_Jskc	Teacher code	Invarchar	No
course_Tel	Course code	Varchar	No
course_Yx	Class time code	Varchar	No
course_Bz	Remarks	char	No

As shown in Table 1, the intelligent course scheduling database includes name, name, teacher code, course code, class time code, remarks and other information data. In order to meet the requirements of task design by intelligent course scheduling method, before course scheduling, we must master the teaching objectives of the whole textbook, the distribution of knowledge points and the relationship between knowledge points. Then fully understand students' basic knowledge and ability level, as well as students' interests and hobbies. Finally, according to the content of the textbook and the situation of students, the order and combination of knowledge points in the textbook are appropriately adjusted, and a series of classroom tasks with clear objectives are designed.

2.3 Realize Intelligent Course Scheduling of Single Chip Microcomputer Application Technology

The process of solving the timetable problem is to find a suitable time and classroom for each course scheduling task. This group of time and classroom meet the experience and

common sense, constraints, and do not conflict with other course scheduling tasks [10, 11]. In addition, the curriculum arrangement should take into account a large number of restrictions and requirements, which can also be divided into two categories: those that must be met and those that should be met as far as possible. Restrictions that must be met, such as the classroom in which certain equipment must be used for a course, otherwise teaching cannot be carried out; A course cannot be scheduled at a certain time because the instructor has other tasks at these times. Necessary consideration shall be given to the requirements that can be met as far as possible. If they cannot be met, the implementation of the whole timetable shall not be affected. For example, the teacher hopes that his class should be arranged at a certain time or in a classroom. For some courses with different number of classes per week, the factor of class weeks should be considered. For example, some classes have different number of classes in one or two weeks, and even some classes are uncertain to have more or less classes in a few weeks in a semester. When allocating time and classrooms to classes with different weeks, we should pay attention to the interpolation between them to make them occupy less time and classrooms as far as possible, so as to improve the utilization rate of classrooms. The above restrictions and requirements are put forward from the perspectives of teachers, students, classrooms and courses. Sometimes they are interrelated and difficult to deal with properly. Therefore, in addition to the basic factors, the more conditions and requirements are met, the more popular the timetable will be.

When the number of visitors to a course exceeds the expected number, the classroom shall be adjusted; Adjust the class time of some classes for some reasons. To sum up, the whole process of arranging the timetable is to "sort" the course scheduling tasks first. The quality of the sorting has a direct impact on the learning effect of the course scheduling and whether the solution of the course scheduling problem can be obtained. The general course arrangement strategy is that the whole school arranges courses in a centralized and unified manner, first large classes, then basic courses, then professional courses, first lower grades, then higher grades, first courses with more hours, and then courses with less hours. According to this strategy, the system sorts the course scheduling tasks and determines the sequence of course scheduling tasks. The course scheduling process is to select the class time and classroom for the arranged course scheduling tasks, but the available classroom resources need to be referred to when selecting the class time. In addition, the course scheduling should make it possible to meet some course scheduling rules, such as various restrictions that must be met and met as far as possible.

Therefore, the correctness rule of course scheduling requires that the timetable accurately reflect the courses of each class and the class time and classroom of the teachers, and meet the following basic requirements: a teacher can only take one course at the same time; At the same time, a class can only take one course; At the same time, a classroom can only take one course; The number of students in class shall not exceed the number of seats in the classroom; Classes must be arranged in the required type of classroom. Rationality rule: the schedule is required to comply with the teaching law, which is conducive to students' effective reception of knowledge and ensure the teaching quality. The specific performance is that the schedule of a class is uniform. That is, the number of class hours per day in a week should be uniform. The schedule of each course is uniform. That is, the interval between two courses of a course should be basically uniform. Some

important courses with greater difficulty are generally arranged in the morning. Such as: MCU application technology, etc. Adaptive rules: the requirements affected by uncertain factors shall be met as far as possible. These rules will be different every semester. For example, a course is arranged at the specified time or times of the week. A teacher's curriculum is scheduled to attend classes at a specified time every week. Class scheduling status reflects the use of class and teacher schedules, idle time slices, available classroom resources and other information involved in a task before it is arranged. Through the course scheduling status, you can know the set of time slices that can be arranged for the current task. The biggest problem encountered in Course Scheduling with reinforcement learning algorithm is the discretization of the schedule state. If the discretization is too large, it may bring dimension disaster. This paper has noticed a characteristic of the course scheduling problem itself, that is, the courses arranged in a timetable must meet four requirements: time does not conflict; Classroom resources are available; Embodiment of special requirements; The embodiment of weekly nature. In this way, the state of each time slice of the timetable can be discretized into the above four variables, which not only meets the requirements of the course scheduling algorithm, but also reduces the dimension of the state space. Based on the above considerations, this paper divides the timetable into 20 vectors according to the time slice (i.e. 5 days of classes, 4 classes per day), and each vector contains the above four elements. Each course scheduling task has a classroom or classroom type requirement. In this paper, the classroom that meets the number of course scheduling tasks is called available classroom. Firstly, this paper obtains the total amount of available classrooms, and then calculates the installed displacement of available classrooms one by one for each time slice of the timetable. Finally, this paper obtains an availability ratio, which reflects the tension of classroom resources. The higher the value, the higher the use degree of this kind of classroom in a certain time slice, which belongs to tight resources. Arranging the action is to arrange the course on the day of the week and the section. At the same time, the arrangement of actions must also reflect the nature of weeks, such as single and double weeks. There are 20 time slices according to the timetable, and each time slice is represented by 3-bit binary. The first bit indicates whether it is arranged here. The arrangement is 1, otherwise it is 0. The 2nd and 3rd digits represent single and double weeks, 01 for single week, 10 for double week and 00 for others. In this way, this paper uses 60 0 and I characters to form a unified string, which is represented as follows: 100, 110… 000. In this paper, in the actual course scheduling process, we can set the action set that can be arranged according to the actual schedule state and course scheduling task, and select the action from the action set that can be arranged. In the actual course arrangement, we need to consider the teaching resources of course arrangement and the rationality of arrangement. The influence of these two points on the choice of arranged actions is also reflected in the influence on the set of actions that can be arranged. According to the above methods, the course scheduling time of the intelligent course scheduling method can be shortened to further ensure the course scheduling effect of the method.

3 Experiment and Analysis

In order to verify whether the method designed in this paper has the use effect, this paper makes an experimental test on the above methods. The experimental results are presented

in the form of the traditional single-chip microcomputer application technology intelligent course scheduling method, which is compared with the single-chip microcomputer application technology intelligent course scheduling method designed in this paper. The specific experimental process and experimental results are as follows.

3.1 Experimental Process

Before the experiment, considering the shortage of resources, this paper will also conflict with the Course Scheduling in Colleges and universities, and there will be many backtracking situations, resulting in poor performance of the algorithm, and even the dead cycle of the intelligent course scheduling algorithm due to resource competition. Therefore, it is necessary to further optimize the intelligent course scheduling algorithm, set a threshold of backtracking times, schedule courses at each backtracking node, and record the total number of course backtracking. When the backtracking times exceed the preset threshold, the backtracking is terminated and returned to the original root node. As individual courses cannot realize intelligent course scheduling, the effect and process of overall course scheduling are affected. The full credit system teaching mode provides students with the right to choose courses by themselves. After the course schedule is arranged, students can freely choose elective courses through the course scheduling algorithm. Therefore, while intelligent course scheduling, some elective courses should be left to students to choose by themselves, that is, students who attend classes at the same time should be evenly arranged to avoid the phenomenon of crowded classes. The following is the optimized course scheduling algorithm.

Not all courses are treated in the same way. For example, teachers and courses cannot be treated in the same way as others. Once it is the needs of the Academic Affairs Office of colleges and universities, it must be met. Therefore, some course scheduling factors should be considered as priorities in the course of course scheduling. Thus, the description of intelligent course scheduling is shown in Table 2.

Table 2. Description of intelligent course scheduling

Serial number	Intelligent course scheduling description
1	Select a random number and arrange the classes randomly
2	Encode teachers' teaching contents and preset teachers' constraints
3	The teacher array and class array are randomly combined to form a one-to-one course scheduling array corresponding to teachers and classes
4	Code the course scheduling information in the format of: {teacher name, course, number of class hours per week, time period requirements}
5	Check the constraints of course scheduling and schedule courses randomly according to the requirements
6	Check whether the scheduling time conflicts with the classroom

(*continued*)

Table 2. (*continued*)

Serial number	Intelligent course scheduling description
7	Judge whether the course scheduling is completed. If it is not completed, the course scheduling will continue. If it is completed, the algorithm will end
8	The educational administration arranges courses and generates a timetable according to constraints

As shown in Table 2, this paper introduces two factors affecting Course Scheduling: teachers and courses: some external in-service teachers are greater than the constraints of teachers in our school, and their course scheduling priority should be set higher; When teachers have individual constraints, their priority should be set higher; Compulsory courses are more than elective courses, and more credits than less credits; Classrooms are frequently used. The priority of courses taught here is much higher than that in ordinary classrooms; The priority of arranging courses and setting up multiple joint classes is better than that of other classes.

3.2 Experimental Results and Discussion

Under the above experimental conditions, this paper selects the course of single chip microcomputer application technology in chapters 1–5 for course scheduling. The traditional single-chip microcomputer application technology intelligent course scheduling method is compared with the single-chip microcomputer application technology intelligent course scheduling method designed in this paper. The experimental results are shown in Table 3.

Table 3. Experimental results

Chapter	Traditional course scheduling method	This paper course scheduling method
1	56 s	12 s
2	42 s	28 s
3	45 s	36 s
4	28 s	42 s
5	67 s	56 s

As shown in Table 3, under the same experimental conditions, the traditional single-chip microcomputer application technology intelligent course scheduling method has a longer course scheduling time. The higher the chapter, the more courses, and the course scheduling time increases accordingly. The students in Chapter 5 have the most courses, and the course scheduling time is 67s, and the course scheduling effect decreases accordingly. The single chip microcomputer application technology intelligent course

scheduling method designed in this paper has a shorter course scheduling time, less courses in Chapter 1, and the shortest course scheduling time, only 12 s; The students in Chapter 5 have the least courses, and the course scheduling time is 56S, which is still less than 1min. The course scheduling effect is better, which is in line with the purpose of this paper. The reason for the short time of course scheduling in this paper is that the intelligent course scheduling database is designed based on reinforcement learning, and the single-chip microcomputer application technology courses are coded through coding, so as to improve the efficiency of course scheduling.

This paper simulates the traditional course scheduling environment. That is, there are 201 classes, 383 teachers, 141 classrooms, 1087 course objects, and each course object has 4 to 6 class hours. The number of individuals in the population is 1087 and the algorithm adopts MPGA. Set the population number to 2. Also run 100 times. The comparison data are shown in Table 4.

Table 4. Index comparison results

Data item	Traditional course scheduling method	This paper course scheduling method
Average number of iterations	256	58
Average operation time	36.651 s	11.56 s
Maximum iterations	683	65
Maximum operation time	87.912 s	13.61 s
Minimum number of iterations	113	50
Minimum operation time	12.538 s	10.33 s

It can be seen from Table 4 that the indicators of the intelligent course scheduling method of single chip microcomputer application technology designed in this paper are better than the comparison method. Among them, the average operation time of the intelligent course scheduling method designed in this paper is only 31.5% of that of the comparison method, and the average number of iterations is only 22.66% of that of the comparison method. These two indicators are enough to show that the efficiency of the intelligent course scheduling method designed in this paper is high.

4 Conclusion

In order to ensure the efficiency and accuracy of the intelligent course scheduling method, this paper proposes an intelligent course scheduling method based on the single chip microcomputer application technology based on reinforcement learning. From the collection of single-chip microcomputer application technology course scheduling data,

the design of intelligent course scheduling database based on enhanced learning, and the realization of single-chip microcomputer application technology intelligent course scheduling. The experimental results show that the proposed method can realize the curriculum information query and resource sharing. With the irregular changes of educational administration course scheduling requirements, the course scheduling function of intelligent course scheduling method also changes. Therefore, new requirements appear, and the new business and new requirements of intelligent course scheduling management method are further expanded, improved and improved. Improve the interface beautification of intelligent course arrangement management method to make its appearance more comfortable and operation more convenient. Set flexible course scheduling constraints, increase the flexibility of course scheduling, consider arranging the schedule according to classes and courses, and give priority to slightly special and important courses. Add the function of intelligent course adjustment. The time and venue of a course can be adjusted in the program, which may cause chain changes. Make the timetable of course scheduling function more reasonable and perfect.

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