

# A Random Search Algorithm on Multi constraint Nursing practice with scheduling

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## Abstract:

The role of nursing practice scheduling is to improve the quality of nursing teaching in hospitals, and to provide a certain degree of job security for nursing practice. In a certain sense, the problem of the nursing scheduling is a combinatorial optimization problem under multiple constraints, and the current nursing practice scheduling problem has many constraints. At the same time, with the increase of intern departments in recent years, the internal scheduling of hospitals is becoming more and more complex. On this basis, this paper proposes a mathematical model of multi constraint nursing practice scheduling. The main purpose of this model is to meet the needs of most members of the nursing practice scheduling, using intelligent algorithm to solve the problem of multiple constraints in practice scheduling, to achieve the purpose of scheduling some nursing interns. This algorithm is conducive to the optimal scheduling of nursing scheduling.

**Keywords:** Intelligent algorithm; nursing; internship; scheduling; multiple constraint problems.

## 1. Introduction

Nursing practice plays a very important role in nursing students. It represents a process of transition from theoretical knowledge to practice for nursing students, and is an important stage that many nursing students must go through. It represents the close relationship between the relevant theoretical knowledge acquired by nursing interns and the real nursing diagnosis. In China's large and medium-sized hospitals, hospitals have arranged targeted work for nursing interns, which is also part of the hospital. The hospital is a place where a variety of projects, such as prevention, medical care and health care, are integrated, and interns from many colleges and universities and professions are received every year. Because of the large number of interns, at the same time, there are obvious differences in the requirements for each intern, there are also some differences in the requirements of internship time. However, the resources of each department in the hospital are limited, and the traditional manual nursing practice scheduling method makes the task very severe. Especially in view of the current research on multi-constraints of nursing practice scheduling, some scholars proposed an intelligent algorithm to solve the multi-constraints of nursing practice scheduling problem.

## 2. Nurse Scheduling Problem

At present, the nursing work plays a very important role in the whole hospital. It is easy to see the nurses in any department. At the same time, nurses take on special tasks in medical practice, which is the basis of the whole hospital operation. In China, the shortage of nurses is very serious. This phenomenon has attracted wide attention

from all walks of life. Because nurses are in a special environment for a long time, they may come into contact with a variety of patients anytime, anywhere. Nursing itself has to bear multiple pressures and burdens because of the long-m stress of mental work or the impact of scheduling. Based on this, scientific management of medical staff, effective control of hospital care costs is a hot topic. Under the influence of the current nursing workload and irregular shift system, the interests of hospitals and nurses are affected to some extent. In order to ensure the quality of nursing is not affected, and to reduce the cost of hospital care, the establishment of a reasonable nursing practice scheduling model is of great significance. The research on nurse scheduling problem abroad is earlier than that in China. In a certain sense, mainly some simple manual scheduling, so the lack of a certain optimization mechanism. Shen Yindong, on the basis of literature review on nurse scheduling abroad, used the matrix vector method to evolve the constrained nurse scheduling problem. But the model has strong Western characteristics in the process of building, and there are great differences between the domestic situations.

### 3. Nursing Practice Scheduling Model

The problem of nursing practice scheduling based on intelligent algorithm refers to arranging the students of different schools in a specific period of time corresponding to the students' majors, and making each schedule can meet the specific constraints of each practice. The main constraints are as follows: first, students take part in practical activities every week. Second, students must go to the Department during the internship period. Third, the avoidance of departments should not occur during the internship. Fourthly, the practice nurses must be in the process of making the practice section. Fifthly, for similar departments, the practice nurses can only go to one. Six, the staff arrangement of the practice section should be stable. Seventh, it is necessary for some departments to make arrangements for them as far as possible. The above constraints are all constraints that may arise in the process of data processing.

- **The model of scheduling**

In this paper, we can describe the scheduling model of a single intern, and calculate it from a certain point of time, that is, the first day of internship as the internship time. On this basis, according to certain rules randomly selected departments, among them, each practice between departments have an obvious feature, that is, practice can be divided into one week department, two weeks department, three weeks department. That is to say, the internship time can be divided into 1 week, 2 weeks and 3 weeks, as shown in Table 1. Based on this, in order to ensure that each department in a specific period of time will be arranged for internship nurses. In addition, the same type of internship departments need to be avoided, that is, the same intern nurses are not allowed to enter the same type of departments. For example, the operating room and the interventional operating room in the hospital belong to the same kind of departments, and the psychiatric department 1 and the psychiatric department 2 belong to the same department, namely the psychiatric department. We can express the collection of departments by  $D$ , the concentration of interns by  $S$ , and the burden of departments by  $B$ .

**Table 1.** The nurse scheduling

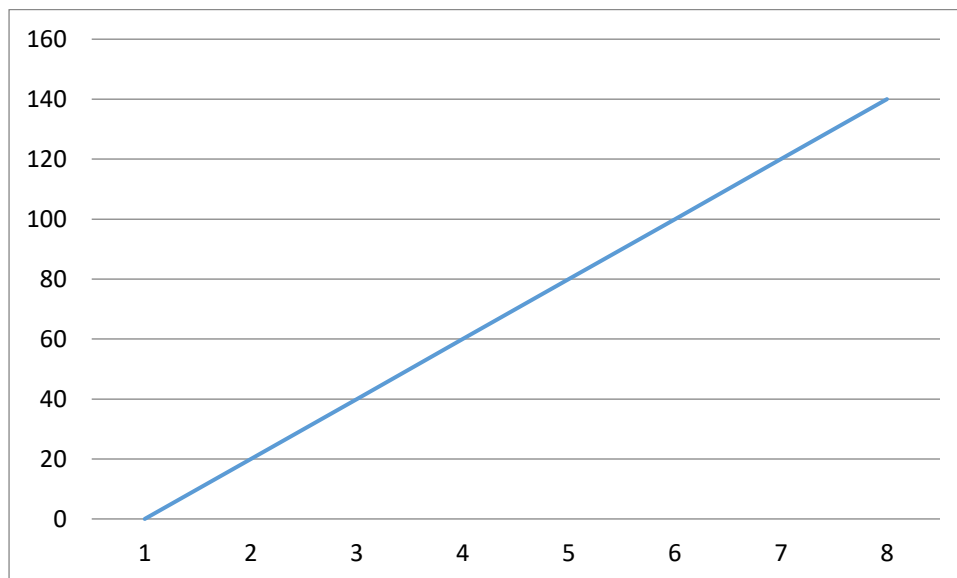
Shifts	Day 1			Day 2			...	Day 7			Number of shifts
	M	E	N	M	E	N	...	M	E	N	
Nurse 1	■			■			...	■			6
Nurse 2	■	■					...		■	■	7
Nurse 3		■			■		...	■			7
Nurse 4			■			■	...		■		7
.....	...	...	...	...	...	...	...	...	...	...	...
Nurse J		■	■				...		■		6
Number of nurses assigned	15	18	13	13	18	13	...	13	14	13	314

- **Algorithm Design**

Research on nurse scheduling problem based on random search algorithm. Random search algorithm refers to the need to randomly search a suitable department from the Department set  $D$  into the corresponding intern time series, until the scheduling time saturation. The following is the description and study of multiple constraints in nursing practice scheduling based on stochastic search intelligent algorithm: Firstly, one student  $S_1$  (strati, endi,  $t_i$ ) is selected randomly from the set  $S$  of interns, and the initial  $T_i = start_i$  is divided into three subsets:  $D_1$ ,  $D_2$  and  $D_3$ . Secondly, we randomly select a department from the set of interns  $S$  and conduct a validation test. If the conditions meet, they will be filled in the internship sequence, which contains the following control conditions: When the value of  $t_i \% 6$  is zero, it is necessary to select randomly from the set  $\{2, 3\}$  in the set  $D_1$  of the required departments. If each department cannot meet the constraints, then it is necessary to randomly select from the Department subset  $D_3$ . How can it still not meet the requirements of the constraints, we need to take  $k_i = 1$  as the condition for random extraction, how can it still not meet the constraints, and then analogy, continue to randomly extract in  $D_3$ . If it still does not meet the constraints, then continue to "+1" on the time point. When  $t_i \% 3 = 0$  is used, it should be selected randomly in  $D_1$  and  $k_i = 3$  as the limiting condition. If the condition is not satisfied, the random selection is continued in  $D_3$ ; if it is still not satisfied, the analogy is continued.

#### 4. Results

In a sense, random algorithm is an intelligent algorithm based on conditions and extended rules. This algorithm has certain characteristics, that is, random search algorithm can be regarded as a solution tree in fact, and finally can get a solution to the scheduling problem. A total of 300 nursing interns were counted by manual mode scheduling, as shown in Figure 1.



**Figure 1.** The scheduling time on random algorithm

According to Fig. 1, we can see that the traditional scheduling method consumes too much time when dealing with the scheduling problem. It only takes a few minutes to realize the scheduling problem for hundreds of interns, which greatly improves the scheduling efficiency. For the balance of scheduling, there is still no complete set of criteria to measure it. After the practice of this method, the interns in the Department have basically achieved the balance, and the effect of the practice has also been improved. It reflects from the side that the algorithm based on random search can solve the constrained problem of the practice scheduling.

#### 5. CONCLUSION

Nursing interns scheduling problem has been plagued by the hospital nursing interns scheduling problem, on a single intern scheduling problem is relatively simple, but on the whole hospital interns scheduling problem, it is a very serious problem. The traditional scheduling problem is to use the principle of filling in the schedule of different lengths, so as to achieve the principle of the shortest idle time. In a certain sense, the researcher optimizes the scheduling work from the management point of view, and improves the scheduling model. To a certain extent, it solves the contradiction between the imbalance of human resources and patients' expectations.

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