Scheduling Algorithm Applications to Solve Simple Problems in Diagnostic Related Health Care Centers

L. Sreenivasulu Reddy, V. Vasu, M. Usha Rani

Abstract*— Scheduling algorithms focuses on the applications of analytical methods to facilitate better decision making. This paper aims to raise the awareness of diagnostic specialists with regard to practical scheduling algorithm applications. Scheduling algorithm applications used as part of mainstream decision making by diagnostic centre specialists. Common people in the real world facing so many solvable problems each and every day in diagnostic centers for malaria parasite checkup. If diagnostic specialist takes proper care then it is solvable simple problems. Also it is a good encouragement to everyone for checking their blood whether it is infected with parasite or not. It's also helpful to supporting staff. We explained basic applications along with problems with suitable simple solutions through scheduling algorithm techniques and graph theory approach too.

Key Words*— Microscopy, scheduling algorithms, waiting time, image processing, Malaria parasite.

I. INTRODUCTION

Malaria is a killer disease [1]. One million children die of it every year. The disease leaves many others weak and unable to work or study properly. Malaria is spread by Anopheles mosquitoes and affects people in many countries. It is even coming back to countries from which it has been driven out [7,5]. There are important government programmes to control malaria and we all need to work together to support these and prevent malaria from spreading. Children can also help by preventing mosquitoes from breeding and biting people, and by knowing what to do when someone has malaria[3,8]. To prevent malaria we must stop Anopheles mosquitoes from biting people by Keeping mosquitoes away, Killing mosquitoes, filling up puddles of still water around the house with earth and stones etc., [2,4] Frequently we have to check malaria parasite at diagnostic centers based on the symptoms of malaria namely suffering fever, headache, joint pain etc., common people facing so many problems at diagnostic centers at the time of parasite checking. All problems are simple and solvable with proper care by diagnostic specialists [6,9].In this paper we explain some applications along with problems and simple solutions through scheduling algorithm applications. The following are some of problems at diagnostic centers along with solutions in different scheduling algorithm approaches.

We hope this article may helpful to the all diagnostic centre specialists all over India.

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II. OUTPATIENT APPOINTMENT SCHEDULING FOR PARASITE BLOOD CHECKING.

Problem: Long waiting time at outpatient clinics before consultation.

In India, patients need to make an appointment for a diagnostic centre specialist. In theory, an appointment system reduced patient waiting time. In practice, the waiting time can still be substantial. Various rules and algorithms have been proposed in different research work.

The first and simplest outpatient appointment scheduling algorithm is first-come, first-served (FCFS) scheduling algorithm. With this scheme, the specialist requests the person first is allocated the bed first for parasite checkup. The implementation of the FCFS policy is easily managed with FIFO queue. When a person enters in to the queue for appointment and the specialist is free, person is allocated to the specialist at the head of the queue. The running person is removed from the queue.

Consider the following set of patients that arrive at time 0 along with time allocation to each patient given in minutes (table 1). The main constraint for allocation of time to each patient are age,gender,kids, PH etc., for instance, for kids and old age patients we have to allocate more time for parasite detection and for youngster less time is sufficient. Also for PH patients we should allocate more time. Note that whatever criteria mentioned here is just author's opinion and it's not mandatory. If the patients arrived in the order ABCD and are served in FCFS order, we get the result shown in figure1.

Table 1: Appointment schedule

Patient ID	1	2	3	4
Patient Names	A	B	C	D
Appointment Time	15	10	7	12

The waiting time for the first patient (A) is 0 minutes, 15 min. for B, 25min. for C and 32 for D. The average waiting time is 18 minutes. If we change the patient arrive time in the order BCAD then the average W.T. may change. Thus we conclude that the W.T. for patients may vary based on allocation. This algorithm is non-preemptive.

A	B	C	D
0	15	25	32

Figure 1

Once the specialist has been allocated time to a patient, then that patient keeps the specialist until the patient releases the specialist either by completing the total work or by requiring one more patient.

In shortest job first scheduling algorithm, when the specialist available then we allocate patient in such a way that patient having less time allocation in the appointment. In this case, patient having less time in appointment can complete parasite checkup process early. Also the average waiting time decreased when compared to FCFS.

In priority scheduling algorithm, we have to give priority to patients appointments for parasite checking based on the some criteria namely age, gender, PH etc., for instance, the first priority goes to old aged people, second priority goes to kids etc., consider the patient appointment schedule along with priority as shown in table 2.

In the table 2, low numbering system represents high priority. In this case we can justify all kinds of people due to priority. Based on the priority from the table 2, the patients arrived in the order RSPQ and the average waiting time is 19.7 minutes. The average time may increases or decreased when compared to previous methods but the priority is the key role.

Patients	P	Q	R	S
App. time	10	7	15	12
Priority	3	4	1	2

Table 2

The Round Robin algorithm is designed especially for time sharing system. RR is similar to FCFS but preemption is added to switch between patients. A small unit of time called time quantum is defined. In process of parasite checking, there so many steps namely taking blood from the person, preparing blood smear, analysis of smear in microscope and final interpretation etc.,. In all previous algorithms we have to do all these steps within time allocation of patient. Wasting of time is possible while using above discussed algorithms between each step of parasite checking. In this method we can avoid wasting of time between each step. In this case, we have give break to patient between each step namely time quantum so that simultaneously we can do work with more than one patient at a time. This leads to saving patient, specialist time and possibility of testing more patients. Here we can minimize average waiting time of patients. The RR algorithm is preemptive i.e., repetition of same patient (as shown in fig.2). In the following chart, the time quantum is 5 minutes.

A	B	A	C	B	D	C	A	C	D
0	5	10	15	20	25	30	35	40	45

Figure 2

In summary, the above discussed algorithms having merits as well as demerits but the best suitable algorithm is Round Robin algorithm.

III. BED ALLOCATION BY SPECIALTIES

Problem: overflow of patients in wards

The demand of diagnostic centre inpatient bed by medical specialties changes according to patient's volume over time. With no adjustments to the allocation of beds, the growing mismatch will result in unnecessary patients overflow. This will lead to poorer patient care and longer bed waiting time. Hence diagnostic center specialist need to periodically review their bed allocation by specialties.

Under the normal situation a patient may utilize a bed in only the following sequence so that we can avoid overflow of patients in wards.

(i) If the bed can't be granted immediately (for instance, if the bed is being used by another patient) then the patient must wait until it can acquire the bed

(ii) The patient released the bed after the final interpretation based on specialist permission.

(iii) The patient can utilize the bed properly.

The overflow of patients in wards problem can be described more precisely in terms of digraph (figure 3)

The graph consists of a set of vertices V and a set of edges E. the vertex set V consists of different types of nodes $B=\{B_1,B_2,B_3,\ldots\ldots,B_m\}$ and $P=\{P_1,P_2,P_3,\ldots\ldots,P_n\}$. A directed edge $P_j \longrightarrow B_i$ is called a request edge and a directed edge $B_i \longrightarrow P_j$ is called an allotment edge.

To illustrate this concept, let us take five patients and three beds in different wards. Patient P_1 is waiting for the bed B_1, which is allocated to patient P_2. Patients P2 and P_5 requesting Bed B_2 which is held by P_3, P_4 and P_3 requesting third bed which allocated to P_1 and so on. In all cases there is a no proper allotment of bed to patients leads to overflow of patients in wards. In this case, a cycle in the graph is necessary condition for the existence of overflow of patients in wards. From figure3, we have a cycle

P1->B1->P2->B2->P3->B3->P1

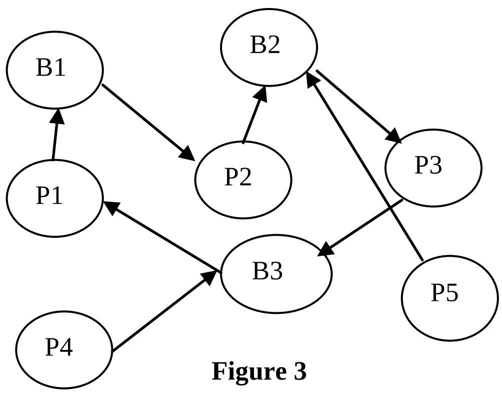

Figure 3

Now our aim to suggest a method to reduce/avoid overflow of patients in wards. This can be achieved by using digraph without cycle (fig.4).

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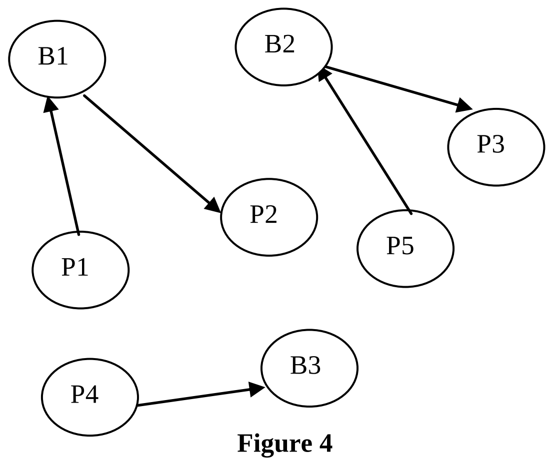

Figure 4

From the figure 4, we can't construct any cycle and completely reduced overflow of patients in wards. This shows that a proper care of allotment of wards to patients reduces the mentioned problem with the help of digraph. In summary, a graph does not have a cycle, then we can avoid overflow problem. If there is cycle then overflow of patients in the wards.

IV. DISCUSSION

Several scheduling algorithm applications have been described in this paper. Also graphical solution to overflow problem described in simple way. There are other health care areas where these applications will be useful. Even we can find so many problems in diagnostic centers and maximum problems are solvable through various applications. We hope this paper raises the awareness and adoption of scheduling algorithm applications amongst diagnostic specialists all over India.

REFERENCES

1. Andrew G Dempster and F Boray Tek: Computer vision for microscopy diagnosis of malaria. Malar J. 2009; 8: 153.
2. Brailsford S: Overcoming the barriers to implementation of operations research simulation models in healthcare. *Clinical and Investigative Medicine*, 28, (6), 312-315, year 2005.
3. Cayirli T,Veral E,Rosen H:Designing appointment scheduling systems for ambulatory care services. Health Care Manage Sci 2006;9:47-58.
4. Crane AB. Management engineers: a scientific approach to pinpoint a hospital's problems and find common-sense solutions. Hosp Health Netw 2007; 81:50-4 .
5. Fone D,Hollinghurst S, Temple M,Round A,Lester N,Weightman A: Systematic review of the use and value of computer simulation modeling in population health and health care delivery. *Journal of public health medicine, 25 (4).* pp. 325-335. ISSN 1741-3842
6. Krithi Ramamritham and John A. stankovic: Scheduling Algorithms and Operating SystemsSupport for Real-Time Systems. Proceedings of the IEEE :1994.
7. P.M.Rubesh Anand, Vidhyacharan Bhaskar, G.Bajpai and Sam M.Job: Detection of the malarial parasite infected blood images by 3D-Analysis of the cell curved surface. In the Proceedings of the 4th Kuala Lumpur International Conference on Biomedical Engineering, Kuala Lumpur, June 2008.
8. Proudlove N,Boaden R,Jorgensen J: Developing bed managers:the why and the how. Journal of Nursing Management Volume 15, Issue 1, pages 34–42, January 2007.
9. Osamuyimen Igbinosa, Owen Igbinosa, Chenyi Jeffery: A Sequential review on accuracy of detecting malaria parasitemia in developing countries with large restriction on resources. Journal of Medicine and Medical Sciences Vol. 1(9) pp. 385-390 October 2010 .

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