Appointment Scheduling & Room Allocation Application for Hospitals & Clinics using Next-Fit or Worst-Fit Algorithms.

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Abstract

One of the most common operations in the world today is scheduling appointments. Every single day all around the world people are undoubtedly making innumerable appointments, from medical appointments, to work appointments, and even educational appointments, etc. Thus, scheduling appointments has almost become a regular essential for many people in the world. In this project, we aim to build an appointment scheduling console application using C++, to be used specifically by hospitals and clinics. The implementation of this application will reduce the turmoil of the patients. In addition, hospitals and clinics generally consist of many rooms, and many teams of doctors or staff members. Hence, our console application shall be able to not only help in scheduling appointments for patients in hospitals and clinics, but also to help in allocating their teams of doctors or staff members to the rooms in their premises. Throughout the project, the concept of Next-Fit and Worst-Fit memory management algorithms will be used as the fundamental logic behind our application, where one of the algorithms will be used to perform one of our proposed functionalities, while the other algorithm will be used to perform the other functionality, depending on their suitability. This project has found that the Next-Fit algorithm is

more suitable to be used on appointment scheduling functionalities, while the Worst-Fit algorithm is more suitable to be used for Room Allocation functionalities.

1. Introduction

The key objective of this project is to build an appointment scheduling and room allocation application for medical clinics and hospitals by applying the concepts of Next-fit and Worst-fit memory management algorithms in operating systems.

Healthcare appointments are a major operation done by people from all over the world in this modern society. However, in many healthcare premises, the process of scheduling appointments is unfortunately still very inefficient and ineffective. Hence, with the help of some memory management concepts taken from operating systems, our application will be able to aid in improving the appointment scheduling process in healthcare premises.

Not just that, today's healthcare premises are bound to have many teams of doctors or staff members, as well as many different rooms. Hence, it is also a goal of our project to be able to build an application that is able to aid these healthcare premises in allocating their teams of employees to all their available rooms.

Most importantly, this project will utilize the concepts of Next-fit and Worst-fit memory management algorithms in order to create a console application that can solve a real-world problem, so that the audience will be able to understand the mechanics and applications of these algorithms.

2. Problem Statement

Among the few basic needs for humans, healthcare is the foremost. In today's world full of hospitals, clinics and similar healthcare facilities, there is still a lack of proper management for scheduling appointments in some of these important medical facilities.

The current standard operating procedure in the healthcare environment for any patient to make or schedule their appointments is time consuming and somewhat inefficient. A patient who

needs to be examined, prescribed and medicated still has to physically wait in long queues for their turns in order to get an appointment with a doctor. This is a problem that should be addressed immediately as sometimes, people's lives may depend on it. Hence, one of the goals of our project is to create an appointment scheduling functionality such that the healthcare premises shall be able to schedule appointments for all of their patients efficiently and without any errors.

Apart from that, modern healthcare premises such as hospitals and clinics will most likely consist of many teams of employees and also many rooms. Hence, there arises a problem where there is no efficient way of allocating all the rooms to the various teams of staff members. Our project also aims to solve this issue by providing a functionality for the healthcare premises to effectively allocate their teams of staff members into their various rooms.

In short, the two most significant problems that we are trying to solve in this project is the problem of appointment scheduling and room allocation in healthcare premises such as hospitals and clinics.

3. Project Objectives

The specific objectives of the project include:

i. To implement the concept of Next-fit and Worst-fit Memory Management Algorithms into practical real-world applications.
ii. To build an application for Hospitals and Clinics to use to schedule appointments for their patients as well as allocate their teams of doctors to the rooms in their premises.
iii. To identify the suitability of Next-Fit and Worst-Fit algorithms in implementing appointment scheduling and room allocation functionalities.

4. Scope of Project

This project covers the concept of Next-fit and Worst-fit memory management algorithms. The main focus of this project is to demonstrate the purpose of these algorithms using real world examples and problems, in the context of appointment scheduling and room allocation in medical premises such as hospitals and clinics. The demonstration will be done

using a self-developed console application program written in the C++ programming language, to be run on a windows machine terminal.

5. Significance of Project

There are a couple of significance that this project will offer, they include:

i. It will provide a real-world analogy of the concepts of the Next-fit and Worst-fit memory management algorithms in operating systems, to help the reader to understand their concepts.

ii. It will demonstrate exactly which kind of practical real-world functionalities are able to suitably implement the concepts of the Next-fit and Worst-fit memory management algorithms.

iii. It will provide an example of an application which implements the Next-fit and Worst-fit memory management algorithms in its operation, which can be used by real-world entities such as hospitals and clinics which is the main beneficiary of the project.

6. Project Methodology

A well-defined project methodology will be able to provide order and structure to a project (Cohen,2018). The project methodology is crucial in allowing the members involved in the project to always be mindful of the state of the project, and to always have a clear outlook on what actions to take while progressing through the phases of the project. Overall, this project will be implemented in 5 phases:

- **Phase 1**: Project Conception & Initiation.
    - Studying the concepts of Next-Fit and Worst-Fit algorithms, then initiate the project by having a meeting.
- **Phase 2**: Project Definition & Planning.
    - Planning and Defining the scopes, objectives, problem statements, and significance of the project.
- **Phase 3**: Project Mock Up & Testing.

- Testing the utilization of the different algorithms on the different proposed functionalities to determine the most suitable match, by using mock-up prototypes.

- **Phase 4**: Project Implementation.
  - After the most suitable algorithms have been mapped on to their corresponding suitable functionalities, the actual project application shall be implemented.
- **Phase 5**: Final Report Writing.
  - Record the entire process of the project.
  - Abstract and Introductions.
  - Scopes, Objectives, Significance, Problem Statements.
  - Results and Discussions.
  - Conclusions.

7. Design & Implementation

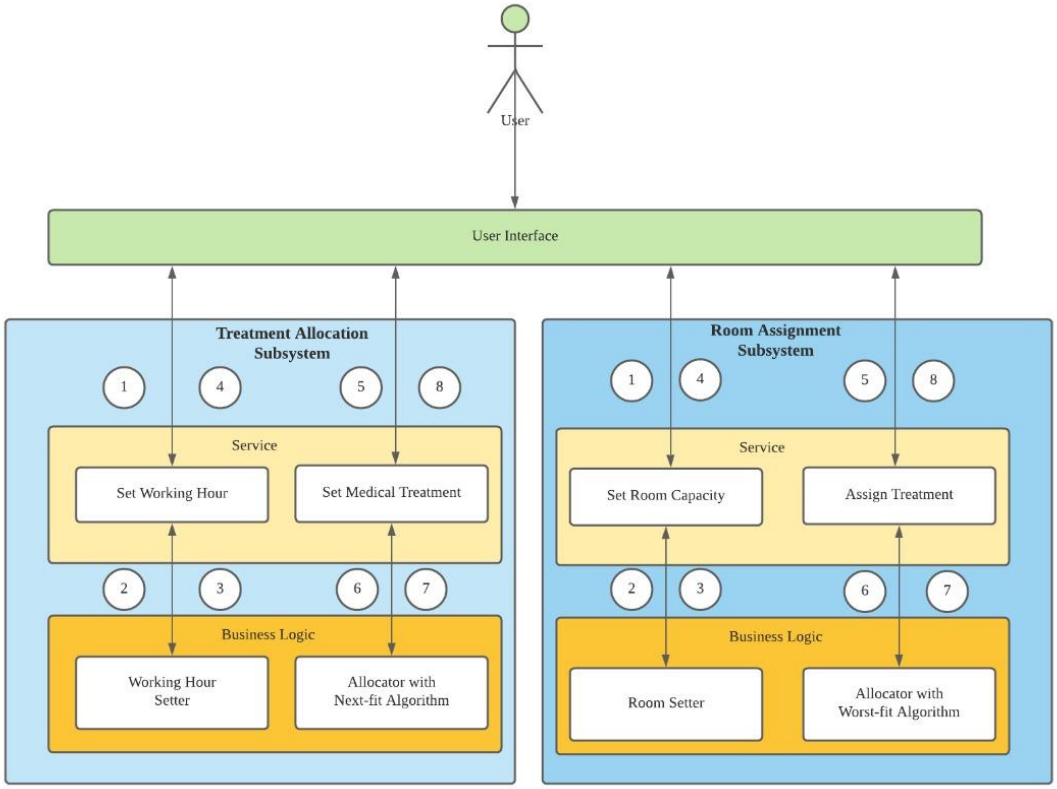

Figure 1: Proposed System Model of this Project.

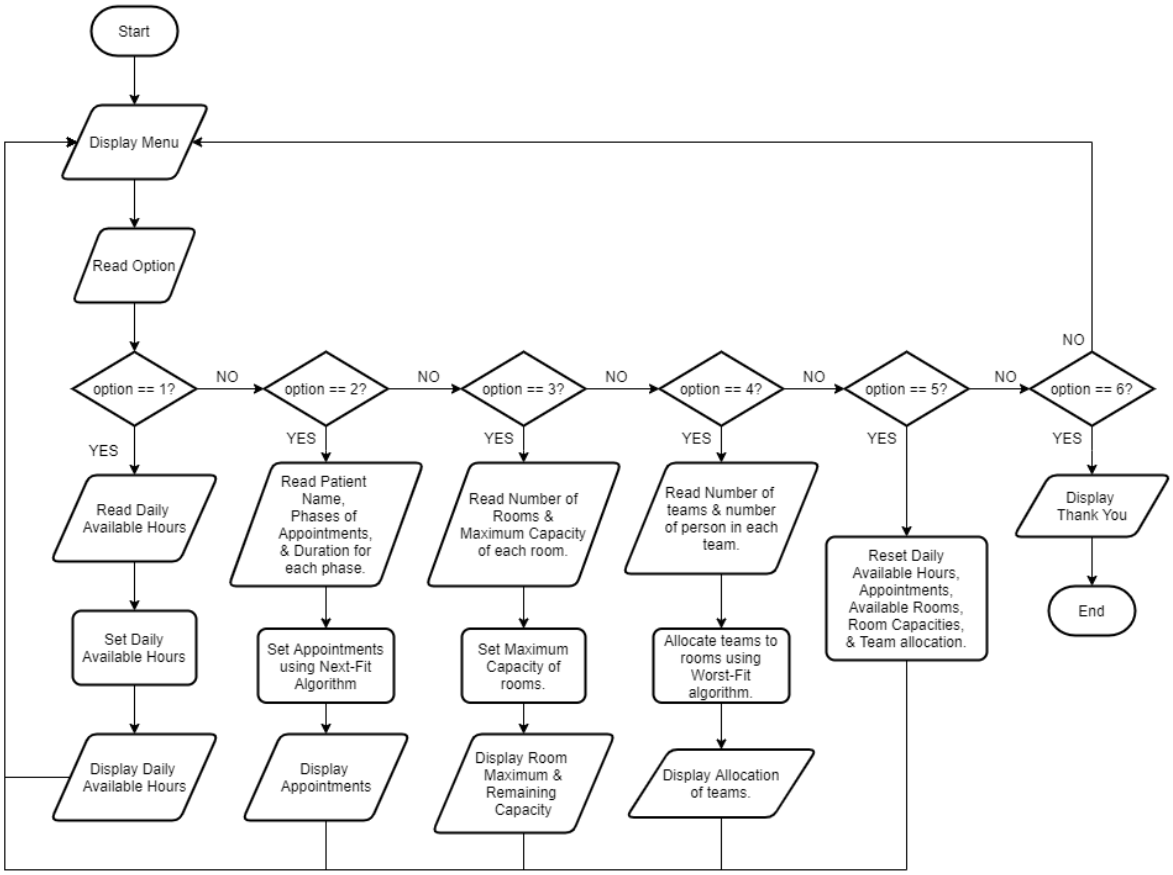

Figure 2: Flowchart of the Application.

8. Results & Discussion

Results from this project have shown that the Next-Fit algorithm is more suitable to be implemented on the appointment scheduling functionality, while the Worst-Fit algorithm is more suitable to be implemented on the room allocation functionality. This is because the Next-Fit algorithm has a sequential characteristic, where it will only continue to search for the next available hole, starting from the previously allocated hole (Silberschatz et. al., 2013). This way, assuming that the holes are weekdays, and the jobs are the appointment phases to be set, we can ensure that the earliest phase of appointment will always be scheduled to a day first, before further phases of appointments are scheduled sequentially after the previously scheduled day. As shown in Table 1 below. If an earlier phase of appointment is not scheduled successfully, then the remaining phases of appointments would not be scheduled as well, as shown in Table 2 below. The Worst-Fit algorithm is not suitable to be implemented on the appointment scheduling functionality because it will allocate the largest hole first, and there are no sequential

characteristics to it, as shown in Table 3 below. Hence, it is clearly shown that the Next-Fit algorithm is most suitable to be used to implement the appointment scheduling functionality.

Table 1: Next-Fit algorithm used on Appointment Scheduling

Day	Mon	Tue	Wed	Thu	Fri
Hours Available	5	7	9	6	4
Appointment Phase		1 (6 hours)	2 (4 hours)	3 (3 hours)	
Remaining Hours	5	1	5	3	4

Table 2: Earlier Phases of Appointments scheduled first. (Next-Fit Algorithm)

Day	Mon	Tue	Wed	Thu	Fri
Hours Available	5	7	9	6	4
Appointment Phase		1 (6 hours)			
Remaining Hours	5	1	9	6	4

- Phase 2 of appointment could not be scheduled within this week (if it needs 10 hours) .
- Phase 3 (3 hours) will not be scheduled as well if the previous phase 2 has not been scheduled yet.

Table 3: Worst-Fit algorithm used for appointment scheduling.

Day	Mon	Tue	Wed	Thu	Fri
Hours Available	5	7	9	6	4
Appointment Phase		2 (4 hours)	1 (6 hours)	3 (3 hours)	
Remaining Hours	5	3	3	3	4

- Phase 2 is scheduled before Phase 1 of appointment, which is illogical.
- Phase 3 will be scheduled before Phase 1 if Phase 2 is too large to be scheduled within this week, which is also illogical.

Next, after using the test data in Table 4 below to study both of the algorithms, this project has found that the Worst-Fit algorithm is more suitable to be used to implement the room allocation functionality. Using the Worst-Fit algorithm, the largest rooms will be allocated before the smaller rooms. This will ensure that the teams of personnel at the hospitals or clinics will always get the most spacious rooms first, so that they have more space to work on their patients. The smaller rooms will only be allocated when all of the larger rooms have already been allocated, as shown in Table 5 below.

However, there is one slight setback of using Worst-Fit algorithm on allocating rooms, where there might be a possibility of smaller teams being allocated to the largest rooms, while the larger teams might not be allocated any rooms as the large rooms have all already been allocated, as shown in Table 6 below.

On the other hand, the Next-Fit algorithm is not suitable to be used to implement the room allocation functionality because it has a sequential characteristic. If the largest team is placed in the beginning of the allocation queue, then there would be very little successful allocation of rooms, as shown in Table 7 below. Hence, it is clearly shown that the Next-Fit algorithm is not suitable to be used to implement the room allocation functionality, while the Worst-Fit algorithm is more suitable to some extent, although it has some limitations.

Table 4: Test Data of Room Allocation

Team	Number of people
1	3
2	7
3	5
4	4

Table 5: Worst-Fit algorithm used on Room Allocation

Room	A	B	C	D	E
Max Capacity	5	4	6	7	9
Team Allocated	4 (4 person)		3 (5 person)	2 (7 person)	1 (3 person)
Remaining Capacity	1	4	1	0	6

- Largest rooms allocated first.
- Smallest rooms are only allocated after all the larger rooms have been allocated.
- Even though Team 1 has only 3 members, it has been allocated the largest room.
- If there are any teams with 9 members and it is not the first team allocated, it will not be allocated to any room.
- The worst case is the team in the queue arranged from smallest to largest and the best case is the team in the queue arranged from largest to smallest.

Table 6: Large Teams not allocated if smaller teams allocated first.

Room	A	B	C	D	E
Max Capacity	5	4	6	7	9
Team Allocated				2 (7 person)	1 (3 person)

Remaining Capacity	5	7	1	0	6

- If Teams 3 or 4 consists of more than 6 members, then they would not be allocated any rooms, even though there are enough rooms to accommodate every team.

Table 7: Next-Fit not suitable for room allocation.

Room	A	B	C	D	E
Max Capacity	5	4	6	7	9
Team Allocated	1 (3 person)			2 (7 person)	3 (5 person)
Remaining Capacity	2	4	6	0	4

- Team 4 cannot be allocated to any room even though Room B and Room C are able to fit the team.
- If Team 1 has 9 members, then no other teams will be allocated to any of the remaining rooms.

9. Conclusion

All in all, appointment scheduling and room allocation are two problems that many modern day healthcare premises have trouble dealing with. This project utilized the concepts of Next-fit and Worst-fit memory management algorithms from operating systems in order to provide efficient and effective appointment scheduling and room allocation functionalities that can aid in solving these real-world issues.

To conclude, the Next-Fit algorithm is applicable to be used for appointment scheduling functionality as compared to using the Worst-Fit algorithm which is inapplicable. The Worst-Fit algorithm is not suitable for scheduling appointments because it does not have a sequential

nature that the Next-Fit algorithm has. On the other hand, the Worst-Fit algorithm is more suitable to be used to implement the room allocation functionality although it has some limitations. Thus, its efficiency and suitability to be implemented on the room allocation functionality needs to be further investigated by comparing it to other algorithms, in future studies. Besides, the Next-Fit algorithm is not suitable to be used for the room allocation functionality because of its sequential nature, which is not present in the Worst-Fit algorithm. Implementing Next-Fit algorithms on the room allocation functionality will leave many unallocated rooms that are capable of fitting the teams.

Lastly, this project showed how the various concepts that are used in operating systems could also be applied as solutions to many of the real-world problems that are faced by humans on a daily basis. These analogies will benefit the reader who is studying operating systems to better understand the mechanism, purpose and implementation of the memory management algorithms.

References

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