# *Dental Clinic Problem*

**Introduction :**

The project is about a dental clinic where a doctor alone with a chair treating his/her patient. First of all, patients will come to the chamber. Then they will wait in the waiting room for the doctor. The doctor will treat those patients one by one. As the doctor finishes treating all the patients, s/he will sleep on his chair. This project will show how the operation will be done sequentially.

**Purpose :**

The purpose of this project is to know how the operating system works. Here, we considered those patients as processes, the doctor as a processor, and the doctor's chair is the critical section. We have to make sure that there is no deadlock or race condition, the operations are executing without any problem.

**Design :**

In this project, we considered all the patients as threads. We've created separate threads for the doctor and patients. We made two different functions for doctor and patient for their own operation. We declare all semaphore, mutex, thread globally and initialize them in the main function.

1) Functions

```
50  void *Doctor(void *parameter){
51      int c=0;
        while(!no_more){
54          sem_wait(&doctorsBed);
55
56          if(!no_more){
57              printf("\n\t\tDoctor is treating.\n");
58              printf("\t\tTreatment Finished.\n");
59              sem_post(&patientOnChair);
60              c++;
61
62          if(chairCount == c || patientCount == c){
63              printf("\n\t\tNo one is in the waiting room. Doctor is sleeping on his chair.\n\n");
64              exit(-1);
65              }
66          }
67      }
68  }
```

```
26  void *Patient(void *number){
27
28      int num = *(int*)number;
29
30      printf("\n\t\tPatient number %d came to chamber.\n", num);
31
32      sem_wait(&waitingRoom);
33      printf("\t\tPatient number %d is waiting in the waiting room.\n", num);
34
35      sem_wait(&doctorsChair);
36      sem_post(&waitingRoom);
37
38      printf("\t\tPatient number %d going to doctor.\n", num);
39
40      sem_post(&doctorsBed);
41      sem_wait(&patientOnChair);
42      sem_post(&doctorsChair);
43
44      pthread_mutex_lock(&treatment);
45      printf("\t\tPatient number %d leaving the chamber after treatment.\n", num);
46      pthread_mutex_unlock(&treatment);
47  }
```

2) Semaphore & Mutex

```
15
16  sem_t waitingRoom;
17  sem_t doctorsChair;
18  sem_t doctorsBed;
19  sem_t patientOnChair;
20
21  pthread_mutex_t treatment;
22
```

**Implementation :**

Here, we have to provide two inputs. First, the number of arriving patients and the second one is the number of empty chairs in the waiting room. Then the process will show all the operations sequentially.

If the number of patients is more than the empty chair, the system will not allow the last extra patients. Then, it will give treatment to all the patients in the waiting room.

Once the doctor finishes treating all those patients, s/he will sleep on his chair. The next first patient will come and wake up the doctor again.

**Testing and analysis :**

1) Case 1 : Empty chairs is more than arriving patients.

```
========================================================================
==================== WELCOME to Dental Clinic ==========================
========================================================================

        Enter the number of patient : 5
        Enter the number of empty chairs in the waiting room: 10

                Patient number 1 came to chamber.
                Patient number 1 is waiting in the waiting room.
                Patient number 1 going to doctor.

                Doctor is treating.
                Treatment Finished.
                Patient number 1 leaving the chamber after treatment.

                Patient number 2 came to chamber.
                Patient number 2 is waiting in the waiting room.
                Patient number 2 going to doctor.

                Doctor is treating.
                Treatment Finished.
                Patient number 2 leaving the chamber after treatment.
```

```
    Patient number 3 came to chamber.
    Patient number 3 is waiting in the waiting room.
    Patient number 3 going to doctor.

    Doctor is treating.
    Treatment Finished.
    Patient number 3 leaving the chamber after treatment.

    Patient number 4 came to chamber.
    Patient number 4 is waiting in the waiting room.
    Patient number 4 going to doctor.

    Doctor is treating.
    Treatment Finished.
    Patient number 4 leaving the chamber after treatment.

    Patient number 5 came to chamber.
    Patient number 5 is waiting in the waiting room.
    Patient number 5 going to doctor.

    Doctor is treating.
    Treatment Finished.

    No one is in the waiting room. Doctor is sleeping on his chair.
```

2) Empty chair is less than arrival patient

```
========================================================================
==================== WELCOME to Dental Clinic ==========================
========================================================================

        Enter the number of patient : 5
        Enter the number of empty chairs in the waiting room: 2
        SORRY...!!! Maximum capacity is 20.
        Please last 3 patient come sometime later.

                Patient number 1 came to chamber.
                Patient number 1 is waiting in the waiting room.
                Patient number 1 going to doctor.

                Doctor is treating.
                Treatment Finished.
                Patient number 1 leaving the chamber after treatment.

                Patient number 2 came to chamber.
                Patient number 2 is waiting in the waiting room.
                Patient number 2 going to doctor.

                Doctor is treating.
                Treatment Finished.

                No one is in the waiting room. Doctor is sleeping on his chair.
```

3) Waiting room is empty.

```
========================================================================
==================== WELCOME to Dental Clinic ==========================
========================================================================

        Enter the number of patient : 1
        Enter the number of empty chairs in the waiting room: 20


        Patient 1 is waking up the doctor.

                Patient number 1 came to chamber.
                Patient number 1 is waiting in the waiting room.
                Patient number 1 going to doctor.

                Doctor is treating.
                Treatment Finished.

                No one is in the waiting room. Doctor is sleeping on his chair.
```

## Conclusion :

This is a project which shows a very short but effective view of implementation of the operating system. Here, we show how processes are turned into threads and then how they execute in the processor without any race condition or deadlock. We did that under the shadow of a dentist and his patient.