

## R1. Identification of the problem you are trying to solve by building this particular app.

---

The app I built is a dental practice online booking system. I was talking with my friends and some of them are dentists, they said most dental practices in Australia still rely on phone call systems for booking appointments. Cause most of the practice is only 1-3 dentists, implementing an online booking system can require additional investment and staff training. This may not be feasible for smaller dental practices or those with limited resources.

---

## R2. Why is it a problem that needs solving?

---

There are lots of benefits of transferring from a phone call booking system to an online booking system for dental practices, even a small one.

Firstly, an online booking system allows patients to book appointments at any time, even outside of office hours. This convenience can increase patient satisfaction and attract new patients. It also can reduce the workload for reception staff, freeing up their time to focus on other tasks. Cause most of time, the reception staff also work as a dental assistant in some practice. This can lead to increased efficiency and productivity within the practice.

Patients can select from available time slots in real-time, ensuring accuracy and avoiding scheduling conflicts with the online booking system. Beside that, it can provide valuable data insights for dental practices, such as appointment history and patient demographics. This information can be used to improve patient experience and inform marketing strategies.

Finally, an online booking system can enhance communication between the practice and patients. Reminders and notifications can be automated, reducing no-shows and improving patient engagement.

Overall, transferring from a phone call booking system to an online booking system can provide numerous benefits for dental practices, including increased convenience, efficiency, accuracy, data insights, and patient engagement.

---

## R3. Why have you chosen this database system. What are the drawbacks compared to others?

---

I choose PostgreSQL database system for this project because it is an open source relational database management system. Since this project is about to build an API webserver, I probably need to deal with a lots of JSON data. Because PostgreSQL allows JSON data to be stored as a native data type, which allows for efficient storage and retrieval of JSON data. It also provides a range of JSON functions and operators that allow for complex queries and manipulation of JSON data within the database. Beside that, PostgreSQL has strong security features, including SSL support, granular access controls, and encryption options. This

makes it a good choice that handle sensitive data cause the booking system will have username and password.

The main drawbacks of PostgreSQL database system is its complexity. It is a complex system that can be challenging for beginners. That means it has a steeper learning curve and may require more time and resources to set up and manage. PostgreSQL may perform worse than others in some scenarios, like read-heavy workloads. The other drawback could be lack of third party tools and applications that are compatible with. For example, MySQL is more widely used and it easier to integrate into an existing technology stack.

ref: <https://developer.okta.com/blog/2019/07/19/mysql-vs-postgres>

---

## R4. Identify and discuss the key functionalities and benefits of an ORM

---

An ORM (Object-Relational Mapping) is a technique in programming that enables developers to establish a link between a relational database and an object-oriented programming language. By introducing a layer of abstraction between the application and the database, an ORM tool facilitates the manipulation of objects instead of tables and SQL queries.

Here are some key functionalities of ORM

1. Mapping between database tables and object-oriented classes:

- This allows developers to work with objects that represent database records, rather than dealing directly with the tables and records in the database. For example, in this project I have a table "users" in PostgreSQL database that stores information about users can be mapped to a User class in python.

2. Automatic generation of SQL queries.

- ORM tools can generate SQL queries automatically to perform database operations. Still use my project as example

```
user = User.query.filter_by(username=user_name).first()
user.f_name = "Eddy"
db.session.commit()
```

The ORM tool will automatically generate the SQL query to update the f\_name of the user with the username = user\_name based on the User Model, it saves developers time and effort.

3. Provides transaction management:

- In a transaction, all operations must either succeed or fail as a whole. If any operation in the transaction fails, the entire transaction is rolled back, and the database is left in its original state before the transaction began. This helps prevent data inconsistencies and ensure the data integrity. For example, if you have an e-commerce website. When a user purchases a product, the database must be updated to reflect the transaction. This involves subtracting the price of the product from

the user's account balance, updating the inventory of the product, and recording the transaction in the order history. If any of these operations fail, the entire transaction must be rolled back, so the user's account balance is not incorrectly updated, the product inventory is not incorrectly reduced, and the order history is not incorrectly recorded.

#### 4. Provides security features.

- ORM tools provide security features such as parameterized queries, input validation, and protection against SQL injection attacks. This helps ensure that the application is secure and that data is protected from unauthorized access. For example, in this project, we define an ORM model for users table using SQLAlchemy. If we try to find specific user, we use

```
user = User.query.filter_by(username=user_name).first()
```

this is equal to

```
SELECT * FROM users WHERE username = :user_name LIMIT 1
```

The username parameter is automatically escaped and sanitized by SQLAlchemy, preventing any attempt to inject malicious SQL code.

#### 5. Provides support for database schema generation and migration.

- ORM tools can generate and update database schema automatically based on changes in the object model, making it easier to manage changes to the database schema over time.

#### 6. Offers database abstraction

- ORM tools provide database abstraction, which allows developers to switch between different database systems without changing the code. For example, if a developer is using an ORM tool to interact with a MySQL database, they can switch to a PostgreSQL database by changing the database connection string without changing the code that interacts with the database.

---

## R5. Document all endpoints for your API

---

### 1. (GET) Home Page (Everyone can access)

<http://127.0.0.1:5000/home>

200 OK    3.72 ms    45 B    5 Minutes Ago ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

```
1▼ [
2    "message": "Welcome to Dental System!"
3 ]
```

---

## 2. (GET) All dentists general infomation (Everyone can access)

http://127.0.0.1:5000/dentists

GET ▾ http://127.0.0.1:5000/dentists    Send ▾

Body ▾    Auth ▾    Query    Headers    Docs

200 OK    6.42 ms    397 B    3 Minutes Ago ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

```
1▼ [
2▼   {
3    "id": 1,
4    "f_name": "Jamie",
5    "l_name": "Lam",
6    "speciality": "Implantology"
7  },
8▼   {
9    "id": 2,
10   "f_name": "David",
11   "l_name": "Keir",
12   "speciality": "Orthodontics"
13 },
14▼   {
15    "id": 3,
16    "f_name": "James",
17    "l_name": "Zvirblis",
18    "speciality": "General"
19 },
20▼   {
21    "id": 4,
22    "f_name": "Jenny",
23    "l_name": "Hong",
24    "speciality": "Cosmetic"
25 }
26 ]
```

---

### 3. (POST) User/Admin Login

<http://127.0.0.1:5000/auth/login>

Required data:

```
{  
    "username": "eddyzhou",  
    "password": "12345678"  
}
```

The screenshot shows a Postman request for a POST login endpoint. The request body is JSON with fields 'username' and 'password'. The response is a 200 OK status with a response time of 6.42 ms and a response size of 397 B, timestamped 3 Minutes Ago. The response body is a JSON array of four objects, each representing a user with fields id, f\_name, l\_name, and speciality.

```
1 [ 2 { 3   "id": 1, 4   "f_name": "Jamie", 5   "l_name": "Lam", 6   "speciality": "Implantology" 7 }, 8 { 9   "id": 2, 10  "f_name": "David", 11  "l_name": "Keir", 12  "speciality": "Orthodontics" 13 }, 14 { 15   "id": 3, 16   "f_name": "James", 17   "l_name": "Zvirblis", 18   "speciality": "General" 19 }, 20 { 21   "id": 4, 22   "f_name": "Jenny", 23   "l_name": "Hong", 24   "speciality": "Cosmetic" 25 } ]
```

If there is anything missing (username/password) in Json file, error will be handled.

POST ▾ http://127.0.0.1:5000/auth/login Send ▾

JSON ▾ Bearer ▾ Query Headers 1 Docs

```
1 {  
2   "password": "12345678"  
3 }
```

401 UNAUTHORIZED 13.5 ms 159 B 1 Minute Ago ▾

Preview ▾ Headers 5 Cookies Timeline

# Unauthorized

{'username': ['Missing data for required field.']}

If the username or password is not correct

401 UNAUTHORIZED 13.8 ms 114 B Just Now ▾

Preview ▾ Headers 5 Cookies Timeline

# Unauthorized

username is not exist

401 UNAUTHORIZED 369 ms 116 B Just Now ▾

Preview ▾ Headers 5 Cookies Timeline

# Unauthorized

password is not correct

## 4. (POST) Signup new user

http://127.0.0.1:5000/auth/signup

Required data:

```
{  
    "f_name": "Abbey",  
    "l_name": "Spence",  
    "username": "abbeyspence",  
    "password": "12345678",  
    "mobile": "0433512626"  
}
```

The screenshot shows a Postman interface with the following details:

- Method:** POST
- URL:** http://127.0.0.1:5000/auth/signup
- Headers:** 1 (one notification)
- Body:** JSON (showing the posted data)

```
1 {  
2     "f_name": "Abbey",  
3     "l_name": "Spence",  
4     "username": "abbeyspence",  
5     "password": "12345678",  
6     "mobile": "0433512626"  
7 }
```
- Response:** 200 OK, 305 ms, 320 B, Just Now
- Preview:** Headers (5), Cookies, Timeline
- Headers:** (partial response shown)

```
1 {  
2     "user": "abbeyspence",  
3     "token":  
4         "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJmcMVzaCI6ZmFsc2UsImlhdC  
I6MTY3ODU5MzU50CwianRpIjoiOGI1MWM5MTEtZDcxMC00MGJhLWIwMmMtM2Y4Mz  
MxYWYyZWQwIiwidHlwZSI6ImFjY2VzcycIsInN1YiI6ImFiYmV5c3BlbmNlIiwibm  
JmIjoxNjc4NTkzNTk4LCJleHAiOjE2Nzg1OTQ00Th9.nNcWnaxbfg09sC36q0K1D  
75TU0b4TEndtATwMj9oI4U"  
5 }
```

Below are some errors handling when request json file has some wrong inputs

From top to bottom

1. username data is missing
2. password is too short, less than 8
3. typo for "f\_", should be "f\_name"
4. username already been used

401 UNAUTHORIZED    2.55 ms    159 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Unauthorized

```
{"username": ["Missing data for required field."]}
```

401 UNAUTHORIZED    2.33 ms    171 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Unauthorized

```
{"password": ["Password must be at least 8 characters long."]}
```

401 UNAUTHORIZED    2.3 ms    199 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Unauthorized

```
{"f_name": ["Missing data for required field."], "f_": ["Unknown field."]}
```

409 CONFLICT    4.95 ms    148 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Conflict

Username is already registered. Please choose another username.

---

5. (GET) Admin get all users' info (Only Admin can access)

<http://127.0.0.1:5000/auth/users>

Need access token from Admin Account, login admin account to get the token Admin account username: eddyzhou, password: 12345678

The screenshot shows a REST API client interface. At the top, it displays a GET request to `http://127.0.0.1:5000/auth/users`. Below the request, there are tabs for Body, Bearer, Query, Headers, and Docs. Under Headers, the `ENABLED` checkbox is checked. The `TOKEN` field contains the value `eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9.eyJmcmVzaCI6ZmFsc2L`. The response section shows a green `200 OK` status, a response time of `25.9 ms`, a response size of `812 B`, and a timestamp of `4 Minutes Ago`. Below the response, there are tabs for Preview, Headers (with a count of 5), Cookies, and Timeline. The Preview tab displays a JSON response with line numbers 1 through 36. The JSON data represents two users, each with a list of bookings.

```
2  {
3     "id": 1,
4     "f_name": "Eddy",
5     "l_name": "Zhou",
6     "mobile": "0433576893",
7     "booking": [
8         {
9             "id": 2,
10            "date": "2023-05-23",
11            "time": "08:15:00",
12            "status": "Close",
13            "dentist": {
14                "f_name": "Jamie",
15                "l_name": "Lam"
16            },
17            "treatment": []
18        }
19    ],
20 },
21 {
22     "id": 2,
23     "f_name": "Teresa",
24     "l_name": "Kerr",
25     "mobile": "0434562378",
26     "booking": [
27         {
28             "id": 1,
29             "date": "2023-02-05",
30             "time": "14:30:00",
31             "status": "Close",
32             "dentist": {
33                 "f_name": "Jamie",
34                 "l_name": "Lam"
35             },
36             "treatment": []
37         }
38     ]
39 }
```

Other returns when token is not given or not an Admin account

A screenshot of a browser developer tools network tab. The top bar shows the status as "403 FORBIDDEN", the time as "4.09 ms", the size as "133 B", and the timestamp as "Just Now". Below the bar are tabs for "Preview", "Headers" (with a count of 5), "Cookies", and "Timeline". The main content area displays the word "Forbidden" in large bold letters, followed by the message "You don't have permission to access system".

## Forbidden

You don't have permission to access system

A screenshot of a browser developer tools network tab. The top bar shows the status as "401 UNAUTHORIZED", the time as "1.75 ms", the size as "44 B", and the timestamp as "Just Now". Below the bar are tabs for "Preview", "Headers" (with a count of 5), "Cookies", and "Timeline". The main content area displays a JSON response with three lines of code: "1 {", "2 \"msg\": \"Missing Authorization Header\"", and "3 }".

---

## 6. (POST) Dentist Login

<http://127.0.0.1:5000/dentists/login>

Required data:

```
{  
  "username": "jamielam",  
  "password": "12345678"  
}
```

The screenshot shows a Postman interface for a POST request to `http://127.0.0.1:5000/dentists/login`. The request body is JSON:

```
1 {  
2   "username": "jamielam",  
3   "password": "12345678"  
4 }
```

The response is 200 OK, with 275 ms latency and 316 B size, received Just Now. The response body is Headers (5) and contains:

```
1 {  
2   "dentist": "jamielam",  
3   "token":  
4     "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJmcMVzaCI6ZmFsc2UsImhdC  
I6MTY30DU5NjYxNSwianRpIjoiYTFkOTNhZTItZTczS00NjkxLWI20WYtNTZkY2  
VkJkwODIzIiwidHlwZSI6ImFjY2VzcyIsInN1YiI6ImphbWllbGFtIiwibmJmIj  
oxNjc4NTk2NjE1LCJleHAiOjE2Nzg10Tc1MTV9.p3LLdrFTKF7o9hmJh0G-  
oVB6VnBh0G7KJG4efxGcx44"  
5 }
```

Same as the user login, other returns should be handled as

From top to bottom

1. typo for "passwords", should be "password"
2. password is not correct
3. username is not correct

401 UNAUTHORIZED    11 ms    142 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Unauthorized

{'passwords': ['Unknown field.']}

400 BAD REQUEST    790 ms    114 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Bad Request

password is not correct

400 BAD REQUEST    3.44 ms    112 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Bad Request

username is not exist

---

7. (POST) Admin create dentist account (Only Admin can do it)

Required data:

```
{  
    "f_name": "Jenny",  
    "l_name": "Leung",  
    "username": "jenneung",  
    "password": "12345678",  
    "speciality": "General"  
}
```

Need access token from Admin Account, login admin account to get the token Admin account username: eddyzhou, password: 12345678

The screenshot shows two API requests in Postman:

**Request 1 (Top):**

- Method: POST
- URL: http://127.0.0.1:5000/dentists/signup
- Body (JSON):

```
1 {  
2   "f_name": "Jenny",  
3   "l_name": "Leung",  
4   "username": "jenneung",  
5   "password": "12345678",  
6   "speciality": "General"  
7 }
```

**Request 2 (Bottom):**

- Method: POST
- URL: http://127.0.0.1:5000/dentists/signup
- Body (JSON):

```
1 {  
2   "user": "jenneung",  
3   "token":  
4     "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJmcmVzaCI6ZmFsc2U  
5       I6MTY3ODU5Nzg4MywianRpIjoiYWRIUjIzMjctZjUyZC00N2I5LTkxYjgtNWUwY2  
6       ExMWFl0GU0IiwidHlwZSI6ImFjY2VzcycsInN1YiI6Implbm5ldW5nIiwibmJmIj  
7       oxNjc4NTk3ODgzLCJleHAiOjE2Nzg10Tg30DN9.aUrs0HDK2frBupX-g9S-  
8       PAWT0VPND-xxvn02WMBvESE"  
9 }
```

**Response:**

- Status: 200 OK
- Time: 293 ms
- Size: 313 B
- Timestamp: Just Now

**Preview:**

- Headers (5):
- Cookies
- Timeline

```
1 {  
2   "user": "jenneung",  
3   "token":  
4     "eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJmcmVzaCI6ZmFsc2U  
5       I6MTY3ODU5Nzg4MywianRpIjoiYWRIUjIzMjctZjUyZC00N2I5LTkxYjgtNWUwY2  
6       ExMWFl0GU0IiwidHlwZSI6ImFjY2VzcycsInN1YiI6Implbm5ldW5nIiwibmJmIj  
7       oxNjc4NTk3ODgzLCJleHAiOjE2Nzg10Tg30DN9.aUrs0HDK2frBupX-g9S-  
8       PAWT0VPND-xxvn02WMBvESE"  
9 }
```

Same as the user registration, other returns should be handled as

From top to bottom

1. username must longer than 4 characters and password should not less than 8 characters
2. dentist's username already been used
3. this is not a admin account

A screenshot of a browser developer tools network tab. The top bar shows the status "401 UNAUTHORIZED", response time "4.43 ms", and size "249 B". The timestamp is "Just Now". Below the bar are tabs for "Preview", "Headers 5", "Cookies", and "Timeline".

# Unauthorized

{'username': ['Username must be at least 4 characters long.'], 'password': ['Password must be at least 8 characters long.']}

A screenshot of a browser developer tools network tab. The top bar shows the status "409 CONFLICT", response time "5.94 ms", and size "120 B". The timestamp is "Just Now". Below the bar are tabs for "Preview", "Headers 5", "Cookies", and "Timeline".

# Conflict

This dentist is already registered.

A screenshot of a browser developer tools network tab. The top bar shows the status "403 FORBIDDEN", response time "6.01 ms", and size "133 B". The timestamp is "Just Now". Below the bar are tabs for "Preview", "Headers 5", "Cookies", and "Timeline".

# Forbidden

You don't have permission to access system

---

8. (GET) Users get their personal info (booking,treatment details)

Authentication: Need access token from specific User Account, login any user account to get the token

<http://127.0.0.1:5000/patient/info>

The screenshot shows a Postman request for `http://127.0.0.1:5000/patient/info`. The request method is GET. The response status is 200 OK, with a duration of 5.43 ms and a size of 309 B, received Just Now. The response body is a JSON object:

```

1 {  
2   "id": 2,  
3   "f_name": "Teresa",  
4   "l_name": "Kerr",  
5   "mobile": "0434562378",  
6   "booking": [  
7     {  
8       "id": 1,  
9       "date": "2023-02-05",  
10      "time": "14:30:00",  
11      "status": "Close",  
12      "dentist": {  
13          "f_name": "Jamie",  
14          "l_name": "Lam"  
15        },  
16        "treatment": []  
17      }  
18    ]  
19  }

```

## 9. (POST) User booking an dental appointment (user account access)

Required data:

```
{
  "date": "2023-05-23",
  "time": "16:00:00"
}
```

Authentication: Need access token from specific User Account, login any user account to get the token

`http://127.0.0.1:5000/dentists/1/booking`

The number(1) in http request is represent the dentist id

The screenshot shows the Postman application interface with two requests for booking a dentist appointment.

**Request 1:**

- Method: POST
- URL: http://127.0.0.1:5000/dentists/1/booking
- JSON Body:

```

1 {
2   "date": "2023-05-23",
3   "time": "16:00:00"
4 }
```

**Request 2:**

- Method: POST
- URL: http://127.0.0.1:5000/dentists/1/booking
- Headers (Enabled):

  - TOKEN: eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9.eyJmcmVzaCI6ZmFsc2L

- Response:

  - Status: 200 OK
  - Time: 105 ms
  - Size: 224 B
  - Timestamp: Just Now

**Preview Response:**

```

1 {
2   "id": 3,
3   "date": "2023-05-23",
4   "time": "16:00:00",
5   "status": "Open",
6   "user": {
7     "f_name": "Teresa",
8     "l_name": "Kerr"
9   },
10  "dentist": {
11    "f_name": "Jamie",
12    "l_name": "Lam"
13  },
14  "treatment": []
15 }
```

The booking part is the most complicated part in this API app. There will be a lots of logical restriction related to this booking request. Here are some of them listed below.

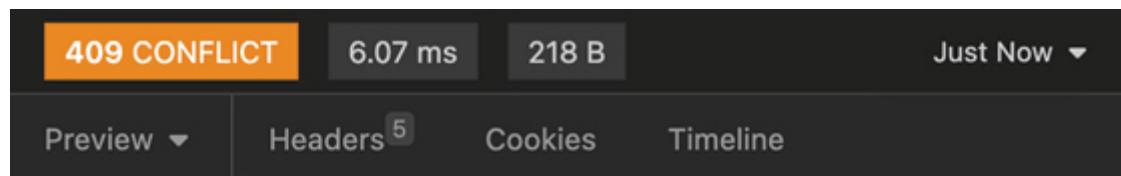
1. Only authenticated user can use booking request
2. The input request for "date" and "time" format should be varified
3. There should be only 1 "Open" booking in user's account, ("Open" booking means user make the appointment, but haven't seen the dentist yet). Once user finished this dental appointment, the status of this booking will change to "Close", then user can make another booking cause there is no "Open" booking under his name. This is used to avoid a user repeatedly making bookings and occupying time slots, preventing other users from being able to book. (If user want to book another time, he need to delete that open booking first)

4. I set each dental appointment is 30 min. Therefore, if that dentist is already booked on that date and time. User need to choose another date or time to book with him. For example: if User A booked Dentist E on April 5th at 16:00:00, then User B can't not book with Dentist E on that date and time, and because of 30 min appointment time, the actual blocked booking time slot is between 15:30:01 to 16:29:59. That means either User B book with another dentist or change another date or choose the time other than 15:30:01-16:29:59.

Here are some returns should be handled as

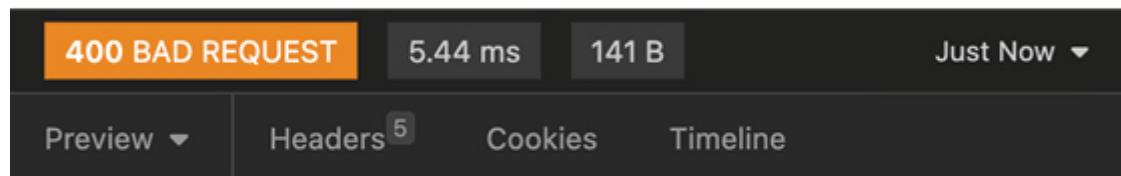
From top to bottom

1. user already has an "Open" booking in the system, need to delete that one before making a new booking
2. the date format should be YYYY-MM-DD
3. the time format should be HH:MM:SS
4. not a valid user, need a valid token to access booking request
5. the booking time user selected is not available, conflict with other user's booking
6. the dentist id is not exist



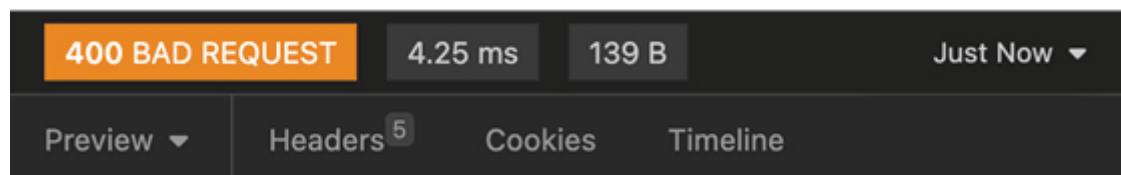
## Conflict

You already have an open booking in the system. Before booking a new one, please ensure to cancel any existing booking in the system.



## Bad Request

Invalid date format. Please use YYYY-MM-DD format.



## Bad Request

Invalid time format. Please use HH:MM:SS format

invalid time format. Please use YYYY-MM-DD format.

A screenshot of a browser developer tools network tab. The top bar shows the status as "401 UNAUTHORIZED", latency as "3.61 ms", and size as "105 B". The timestamp is "Just Now". Below the bar are buttons for "Preview", "Headers" (with a count of 5), "Cookies", and "Timeline".

# Unauthorized

Invalid User

A screenshot of a browser developer tools network tab. The top bar shows the status as "409 CONFLICT", latency as "9.37 ms", and size as "149 B". The timestamp is "Just Now". Below the bar are buttons for "Preview", "Headers" (with a count of 5), "Cookies", and "Timeline".

# Conflict

This time period is already book out, please selete another time

A screenshot of a browser developer tools network tab. The top bar shows the status as "404 NOT FOUND", latency as "3.55 ms", and size as "104 B". The timestamp is "Just Now". Below the bar are buttons for "Preview", "Headers" (with a count of 5), "Cookies", and "Timeline".

# Not Found

dentist not exist

---

10. (DELETE) User delete an "Open" booking under his account (user account access)

Authentication: Need access token from specific User Account, login any user account to get the token

<http://127.0.0.1:5000/patient/cancel>

This is just delete the "Open" booking, other "Close" bookings under that user's name will still be there as records. Return will be all that user's info with his records.

The screenshot shows a REST API testing interface with the following details:

- Method:** DELETE
- URL:** http://127.0.0.1:5000/patient/cancel
- Status:** 200 OK
- Time:** 39 ms
- Size:** 307 B
- Last Updated:** Just Now
- Headers:** 5 (highlighted)
- Preview:** Shows a JSON response with booking details.

```
1 {  
2   "id": 1,  
3   "f_name": "Eddy",  
4   "l_name": "Zhou",  
5   "mobile": "0433576893",  
6   "booking": [  
7     {  
8       "id": 2,  
9       "date": "2023-05-23",  
10      "time": "08:15:00",  
11      "status": "Close",  
12      "dentist": {  
13        "f_name": "Jamie",  
14        "l_name": "Lam"  
15      },  
16      "treatment": []  
17    }  
18  ]  
19 }
```

If there is no "Open" booking under user's account, should return as following

The screenshot shows a REST API testing interface with the following details:

- Status:** 404 NOT FOUND
- Time:** 11.8 ms
- Size:** 125 B
- Last Updated:** Just Now
- Headers:** 5
- Preview:** Shows the error message "Not Found".

**Not Found**

There is no open booking in the system

## 11. (PUT) Dentist change the status of a booking from "Open" to "Close" (dentist account access)

Authentication: Need access token from specific Dentist Account, login any dentist account to get the token

http://127.0.0.1:5000/dentists/3/close

The number(3) in http request is represent the booking id

The screenshot shows a Postman request configuration for a **PUT** method at **http://127.0.0.1:5000/dentists/3/close**. The request is set to **Bearer** authentication. The response is a **200 OK** with **38.4 ms** latency and **225 B** size, received **Just Now**. The response body is a JSON object representing a booking:

```
1  {
2   "id": 3,
3   "date": "2023-05-23",
4   "time": "16:00:00",
5   "status": "Close",
6   "user": {
7     "f_name": "Teresa",
8     "l_name": "Kerr"
9   },
10  "dentist": {
11    "f_name": "Jamie",
12    "l_name": "Lam"
13  },
14  "treatment": []
15 }
```

Here are some returns should be handled as From top to bottom

1. This booking is already closed
2. The booking id in the request is not belongs to you, that means you can't modify other dentist's patient booking
3. Need valid dentist token to access

409 CONFLICT    6.02 ms    116 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Conflict

This booking is already closed!

403 FORBIDDEN    11.6 ms    114 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Forbidden

That's not your patient

401 UNAUTHORIZED    2.93 ms    116 B    Just Now ▾

Preview ▾    Headers<sup>5</sup>    Cookies    Timeline

# Unauthorized

Invalid dentist account

---

12. (POST) Dentist add treatments under his booking (dentist account access)

Required data:

```
{  
    "service": "Full mouth xray",  
    "fee": 120  
}
```

Authentication: Need access token from specific Dentist Account, login any dentist account to get the token

<http://127.0.0.1:5000/dentists/2/add>

The number(2) in http request is represent the booking id

The screenshot shows the Postman application interface with two requests and their corresponding responses.

**Request 1:**

- Method: POST
- URL: http://127.0.0.1:5000/dentists/2/add
- Headers:
  - JSON
  - Bearer
  - Query
  - Headers 1
  - Docs
- Body (raw JSON):

```
1 {  
2   "service": "Full mouth xray",  
3   "fee": 120  
4 }
```

**Response 1:**

- Status: 200 OK
- Time: 11.3 ms
- Size: 65 B
- Timestamp: Just Now
- Headers (5):
- Cookies:
- Timeline:
- Preview:

```
1 {  
2   "id": 2,  
3   "service": "Full mouth xray",  
4   "fee": "120.00"  
5 }
```

Here are some returns should be handled as From top to bottom

1. This booking is belongs to other dentist, you can't add treatments under that booking
2. The booking id is not exist.

403 FORBIDDEN    6.45 ms    114 B    Just Now ▾

Preview ▾    Headers 5    Cookies    Timeline

# Forbidden

That's not your patient

404 NOT FOUND    5.58 ms    104 B    Just Now ▾

Preview ▾    Headers 5    Cookies    Timeline

# Not Found

booking not exist

---

13. (GET) Admin can check all bookings info (Admin account access)

<http://127.0.0.1:5000/patient/bookings>

Authentication: Need access token from Admin Account, login Admin account to get the token  
Admin account username: eddyzhou, password: 12345678

GET ▼ http://127.0.0.1:5000/patient/bookings

Send ▼

Body ▼ Bearer ▼ Query Headers Docs

ENABLED

TOKEN eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9eyJmcmVzaCI6ZmFsc2L

PREFIX

200 OK 9.13 ms 1221 B Just Now ▼

Preview ▼ Headers<sup>5</sup> Cookies Timeline

```
1 [ 
2 { 
3     "id": 1,
4     "date": "2023-02-05",
5     "time": "14:30:00",
6     "status": "Close",
7     "user": {
8         "f_name": "Teresa",
9         "l_name": "Kerr"
10    },
11    "dentist": {
12        "f_name": "Jamie",
13        "l_name": "Lam"
14    },
15    "treatment": []
16 },
17 { 
18     "id": 2,
19     "date": "2023-05-23",
20     "time": "08:15:00",
21     "status": "Close",
22     "user": {
23         "f_name": "Eddy",
24         "l_name": "Zhou"
25    },
26    "dentist": {
27        "f_name": "Jamie",
28        "l_name": "Lam"
29    },
30    "treatment": [
31        {
32            "id": 1,
33            "service": "Comprehensive exam",
34            "fee": "50.00"
35        },
36        {
37            "id": 2,
38            "service": "Teeth whitening",
39            "fee": "80.00"
40        }
41    ]
42 }
```

14. (GET) Admin can check single user info based on user id (Admin account access)

http://127.0.0.1:5000/auth/user/2

Authentication: Need access token from Admin Account, login Admin account to get the token Admin account username: eddyzhou, password: 12345678

The number(2) in http request is represent the user id

GET ▾ http://127.0.0.1:5000/auth/user/2

Send ▾

Body ▾ Bearer ▾ Query Headers Docs

ENABLED

TOKEN eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9eyJmcmVzaCI6ZmFsc2L

PREFIX

200 OK 8.1 ms 517 B Just Now ▾

Preview ▾ Headers<sup>5</sup> Cookies Timeline

```
1 {  
2   "id": 2,  
3   "f_name": "Teresa",  
4   "l_name": "Kerr",  
5   "mobile": "0434562378",  
6   "booking": [  
7     {  
8       "id": 1,  
9       "date": "2023-02-05",  
10      "time": "14:30:00",  
11      "status": "Close",  
12      "dentist": {  
13        "f_name": "Jamie",  
14        "l_name": "Lam"  
15      },  
16      "treatment": []  
17    },  
18    {  
19      "id": 3,  
20      "date": "2023-05-23",  
21      "time": "16:00:00",  
22      "status": "Close",  
23      "dentist": {  
24        "f_name": "Jamie",  
25        "l_name": "Lam"  
26      },  
27      "treatment": []  
28    }  
29  ]  
30 }
```

---

## 15. (PUT) User update their personal info (User account access)

http://127.0.0.1:5000/patient/update

Authentication: Need access token from User Account, login User account to get the token

The screenshot shows a REST client interface with two requests and their responses.

**Request 1:**

- Method: PUT
- URL: http://127.0.0.1:5000/patient/update
- Headers:
  - JSON
  - Bearer
  - Query
  - Headers (1)
  - Docs
- Body (JSON):

```
1 {  
2   "f_name": "Derek",  
3   "l_name": "Lauge"  
4 }
```

**Request 2:**

- Method: PUT
- URL: http://127.0.0.1:5000/patient/update
- Headers:
  - JSON
  - Bearer
  - Query
  - Headers (1)
  - Docs
- Body (JSON):

```
ENABLED   
TOKEN eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9eyJmcmVzaCI6ZmFsc2L
```

**Response:**

- Status: 200 OK
- Time: 21.8 ms
- Size: 737 B
- Timestamp: Just Now

**Preview:**

- Headers (5):
  - Preview
  - Headers
  - Cookies
  - Timeline
- Body (JSON):

```
1 {  
2   "id": 1,  
3   "f_name": "Derek",  
4   "l_name": "Lauge",  
5   "mobile": "0433576893",  
6   "booking": [  
7     {  
8       "id": 2,  
9       "date": "2023-05-23",  
10      "time": "08:15:00",  
11      "status": "Close",  
12      "dentist": {  
13        "f_name": "Jamie",  
14        "l_name": "Lam"  
15      },  
16      "treatment": [  
17        {  
18          "id": 1,  
19          "service": "Comprehensive exam",  
20          "fee": "50.00"  
21        },  
22        {  
23          "id": 2,  
24          "service": "Full mouth xray",  
25          "fee": "120.00"  
26        }  
27      ]  
28    },  
29  ]
```

```
30      "id": 5,
31      "date": "2023-05-23",
32      "time": "16:00:00",
33      "status": "Open",
34      "dentist": {
35          "f_name": "David",
```

In the json file, you can only update "f\_name", "l\_name" or "mobile", but not "username" and "password".

## 16. (DELETE) Admin delete user account (Admin account access)

<http://127.0.0.1:5000/auth/user/delete/3>

Authentication: Need access token from Admin Account, login Admin account to get the token  
Admin account username: eddyzhou, password: 12345678

The number(3) in http request is represent the user id

The screenshot shows a Postman request configuration for a DELETE operation. The URL is `http://127.0.0.1:5000/auth/user/delete/3`. The request method is set to `DELETE`. The status bar indicates a successful `200 OK` response with `8.42 ms` latency and `49 B` size, timestamped `1 Minute Ago`. The `TOKEN` field contains a long access token. The `PREFIX` dropdown is empty. Below the request details, the response body is displayed as JSON:

```
1 {  
2     "Patient Abbey Spence": "has been deleted"  
3 }
```

Here are some returns should be handled as From top to bottom

1. user id is not exist in the database
2. only admin account can access this request
3. even the admin can't delete the admin account

The screenshot shows a browser developer tools interface with the Network tab selected. A single entry is visible with the following details:

- Status: 404 NOT FOUND
- Time: Just Now
- Response Time: 11.8 ms
- Size: 125 B

Below the table, there are tabs for Preview, Headers (with a count of 5), Cookies, and Timeline.

# Not Found

There is no open booking in the system

---

17. (DELETE) Admin delete dentist account (Admin account access)

<http://127.0.0.1:5000/auth/dentist/delete/3>

Authentication: Need access token from Admin Account, login Admin account to get the token Admin account username: eddyzhou, password: 12345678

The number(3) in http request is represent the dentist id

The screenshot shows a Postman request configuration for a DELETE operation:

- Method: DELETE
- URL: http://127.0.0.1:5000/auth/dentist/delete/3
- Headers:
  - Body: Bearer (with a checked checkbox)
  - Query
  - Headers
  - Docs
- Body:
  - ENABLED: checked
  - TOKEN: 0NDB9.U2eHg2nEQYxoKgSnmuse5O3eJZ6kl2qRrD0B1BOb-UU
  - PREFIX
- Response:
  - Status: 200 OK
  - Time: 27.3 ms
  - Size: 51 B
  - Time: Just Now
- Preview, Headers (with a count of 5), Cookies, and Timeline tabs are also visible.

```
1< {  
2   "Dentist James Zvirblis": "has been deleted"  
3 }
```

---

18. (DELETE) Dentist delete treatments (Dentist account access)

<http://127.0.0.1:5000/dentists/5/3/delete>

Authentication: Need access token from Dentist Account, login dentist account to get the token

The first number(5) in http request is represent the booking id, the second number(3) in http request is for treatment id

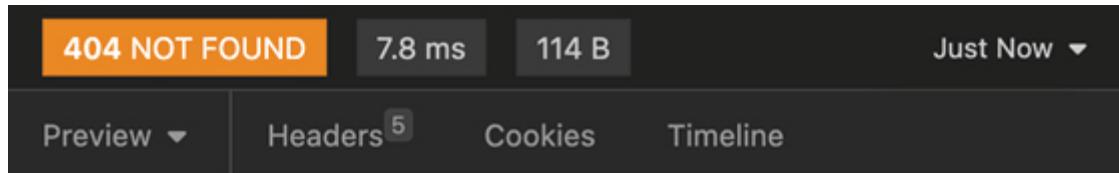
The screenshot shows a REST API testing interface with the following details:

- Method:** DELETE
- URL:** http://127.0.0.1:5000/dentists/5/3/delete
- Status:** 200 OK
- Time:** 10 ms
- Size:** 78 B
- Timestamp:** Just Now
- Headers:** 5 (indicated by a small number in the Headers tab)
- Preview:** Shows a JSON response with 5 lines of data:

```
1 {  
2   "id": 3,  
3   "service": "Posterior filling 2 surfaces",  
4   "fee": "280.00"  
5 }
```

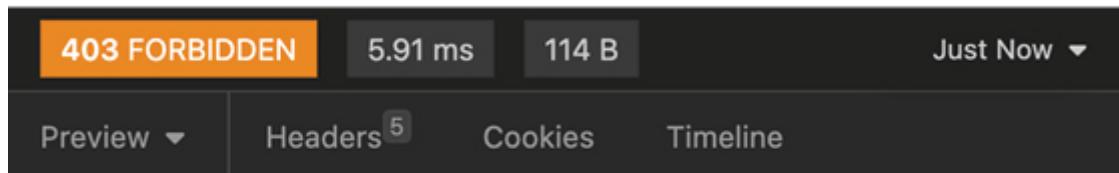
Here are some returns should be handled as From top to bottom

1. Can't find the treatment
2. the booking is belong to other dentists, you can't modify this patient record
3. can't find this booking in database
4. unauthenticated dentist account, invalid token



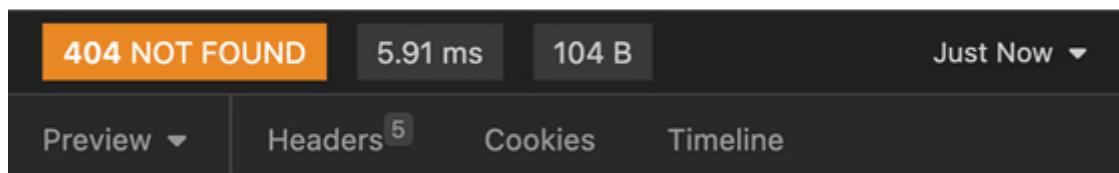
# Not Found

This treatment is not exist



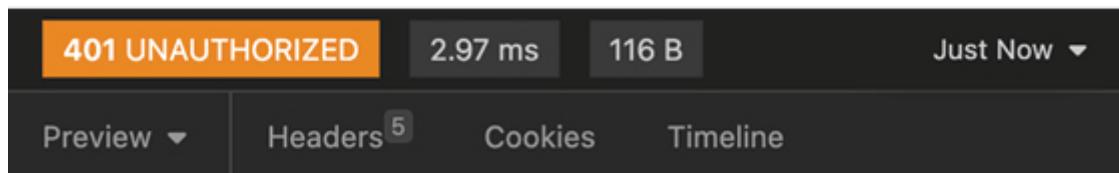
# Forbidden

That's not your patient



# Not Found

booking not exist



# Unauthorized

Invalid dentist account

---

19. (PUT) Dentist update treatments (Dentist account access)

Required data:

```
{
  "service": "Limited exam",
  "fee": 58
}
```

<http://127.0.0.1:5000/dentists/2/1/update>

Authentication: Need access token from Dentist Account, login dentist account to get the token

The first number(2) in http request is represent the booking id, the second number(1) in http request is for treatment id

You can update either "service" or "fee", or both of them.

The screenshot shows the Postman interface with a PUT request to <http://127.0.0.1:5000/dentists/2/1/update>. The request body is set to JSON and contains the following data:

```

1 {
2   "service": "Limited exam",
3   "fee": 58
4 }
```

The response status is 200 OK, with a duration of 26.8 ms and a size of 61 B. The response body is:

```

1 {
2   "id": 1,
3   "service": "Limited exam",
4   "fee": "58.00"
5 }
```

Here are some returns should be handled same as dentist delete treatments

1. Can't find the treatment (second treatment id is not exist)
2. the booking is belong to other dentists, you can't modify this patient record (first booking id is not under this dentist name)

3. can't find this booking in database (first booking id is not exist)
  4. unauthenticated dentist account, invalid token
- 

## 20. (GET) User get total amount of fee from a booking (User account access)

<http://127.0.0.1:5000/patient/2/fees>

Authentication: Need access token from User Account, login user account to get the token

The number(2) in http request is represent the booking id

The screenshot shows a Postman request configuration. The method is GET, the URL is <http://127.0.0.1:5000/patient/2/fees>, and the 'Send' button is highlighted. Below the URL, there are tabs for Body, Bearer, Query, Headers, and Docs. The 'Bearer' tab is selected, showing 'ENABLED' with a checked checkbox and a 'TOKEN' field containing a long string of characters: eyJhbGciOiJIUzI1NilsInR5cCI6IkpXVCJ9eyJmcmVzaCI6ZmFsc2L. At the bottom, the response summary shows '200 OK' with a green background, '6.11 ms' response time, '53 B' size, and 'Just Now' timestamp. The 'Headers' tab is active, displaying the following JSON response:

```
1: {  
2:   "Booking ID": 2,  
3:   "Total amount": "178.00"  
4: }
```

Here are some other returns should be handled as

1. the booking id in http request should exist, otherwise give error message
  2. the booking is belong to other users, you can't check anything related to this booking id
  3. unauthenticated user account, invalid token
- 

## 21. (GET) Search dentists based on the speciality (Anyone can access)

<http://127.0.0.1:5000/dentists/search?speciality=General>

The screenshot shows a Postman API request response. The URL is `http://127.0.0.1:5000/dentists/search?speciality=General`. The response status is **200 OK**, with a response time of **2.71 ms** and a size of **99 B**. The response was received **2 Minutes Ago**. The response body is a JSON array with one item:

```
1 [ 2 { 3 "id": 5, 4 "f_name": "Jenny", 5 "l_name": "Leung", 6 "speciality": "General" 7 } 8 ]
```

---

## 21. (GET) Admin search all open bookings (admin can access)

Authentication: Need access token from Admin Account, login Admin account to get the token Admin account username: eddyzhou, password: 12345678

`http://127.0.0.1:5000/auth/bookings/search?status=Open`

The screenshot shows a Postman interface with the following details:

- Method:** GET
- URL:** http://127.0.0.1:5000/auth/bookings/search?status=Open
- Status:** 200 OK
- Time:** 4.99 ms
- Size:** 259 B
- Timestamp:** Just Now
- Headers:** 5 (indicated by a small number in the Headers tab)
- Body:** A JSON array containing one booking object. The object has fields: id (6), date (2023-05-23), time (16:00:00), status (Open), user (with f\_name: Derek and l\_name: Lauge), dentist (with f\_name: Jenny and l\_name: Hong), and treatment (empty array).

---

## 22. (GET) Dentist get all his bookings (Dentist can access)

Authentication: Need access token from Dentist Account, login Dentist account to get the token

<http://127.0.0.1:5000/dentists/bookings>

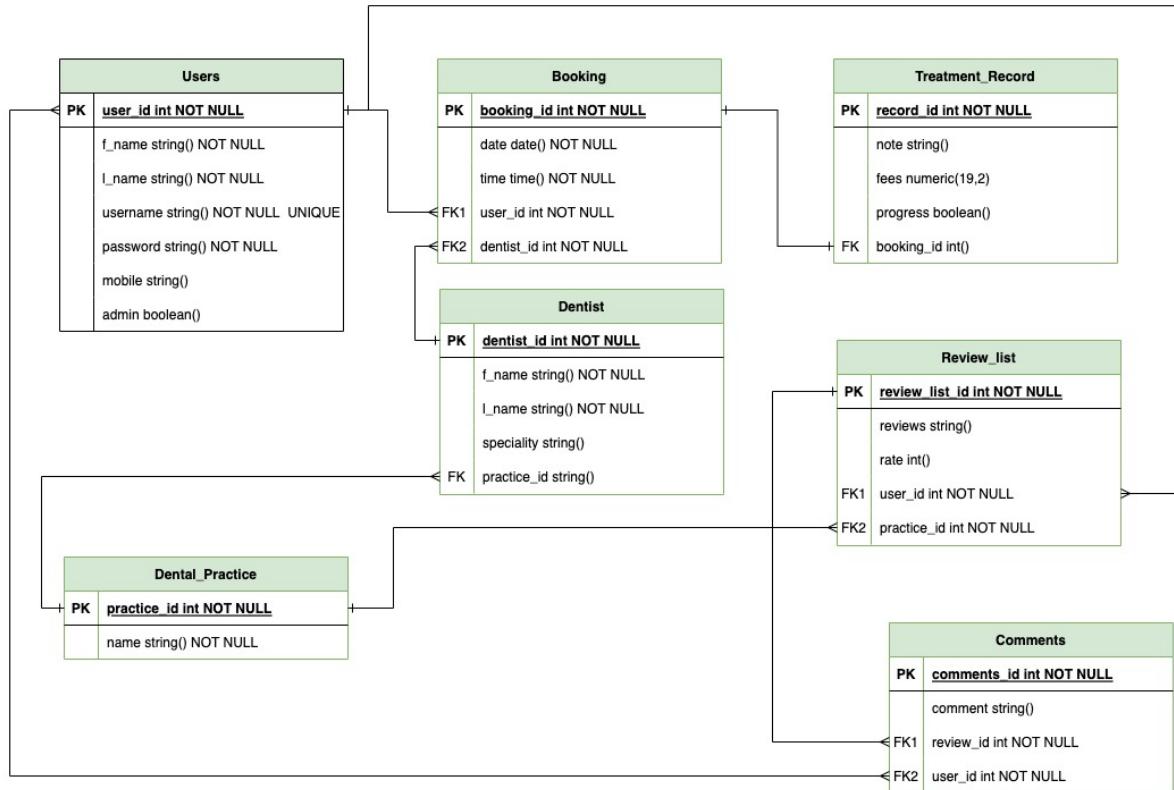
The screenshot shows a Postman interface with the following details:

- Method:** GET
- URL:** http://127.0.0.1:5000/dentists/bookings
- Status:** 200 OK
- Time:** 14.6 ms
- Size:** 750 B
- Last Run:** 1 Minute Ago
- Headers:** 5 (including Content-Type: application/json, Accept: application/json, and Authorization: Bearer <token>)
- Cookies:** None
- Timeline:** None
- Preview:** Shows a JSON array of two booking objects.

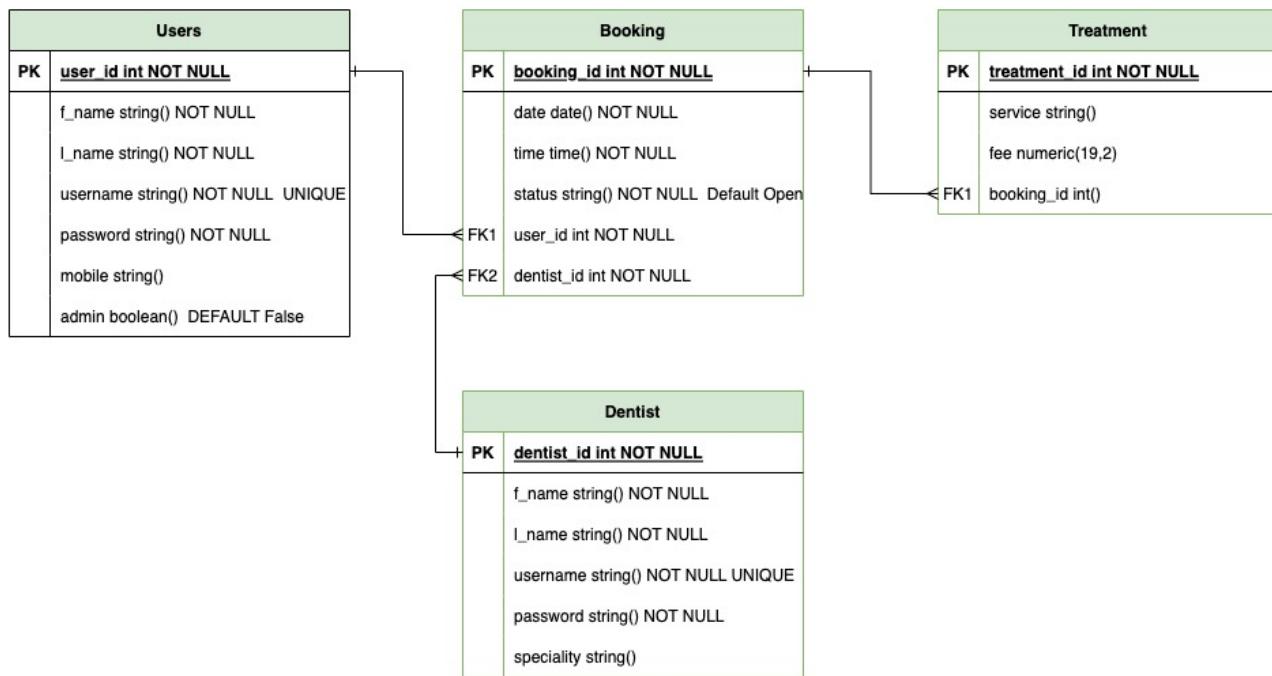
```
1 [  
2   {  
3     "id": 1,  
4     "date": "2023-02-05",  
5     "time": "14:30:00",  
6     "status": "Close",  
7     "user": {  
8       "f_name": "Teresa",  
9       "l_name": "Kerr"  
10    },  
11    "treatment": []  
12  },  
13  {  
14    "id": 2,  
15    "date": "2023-05-23",  
16    "time": "08:15:00",  
17    "status": "Close",  
18    "user": {  
19      "f_name": "Derek",  
20      "l_name": "Lauge"  
21    },  
22    "treatment": [  
23      {  
24        "id": 2,  
25        "service": "Full mouth xray",  
26        "fee": "120.00"  
27      },  
28      {  
29        "id": 1,  
30        "service": "Limited exam",  
31        "fee": "58.00"  
32      }  
33    ]  
]
```

## R6. An ERD for your app

The original ERD when submit on the discord



After discuss, the final ERD more focus on the core functions



## R7. Detail any third party services that your app will use

### 1. SQLAlchemy

```

from flask_sqlalchemy import SQLAlchemy
db = SQLAlchemy()
    
```

SQLAlchemy is a Python library that provides a set of tools for working with relational databases using an object-relational mapping (ORM) approach.

### 2. Marshmallow

```

from flask_marshmallow import Marshmallow
from marshmallow.validate import Length
from marshmallow.exceptions import ValidationError
    
```

```

ma = Marshmallow()
    
```

Marshmallow allows you to define schemas for your Flask models, making it easy to serialize and deserialize them.

```
password = ma.String(validate=Length(min=8))
```

```
#User login the dental system
@auth.post("/login")
def user_login():
    try:
        user_fields = user_schema.load(request.json)
        user =
User.query.filter_by(username=user_fields["username"]).first()
        #Verifiy the username and password, let user know which one is not
correct.
        if not user:
            return abort(401, description="username is not exist")
        elif not bcrypt.check_password_hash(user.password,
user_fields["password"]):
            return abort(401, description="password is not right")
        access_token = create_access_token(identity=str(user.username))
        return jsonify({"user": user.username, "token": access_token})
    except ValidationError:
        return abort(401, description="minimun password length is 8")
```

Using "marshmallow.validate" and "marshmallow.exceptions" can automatically deserialize incoming JSON data and validate it against a Marshmallow schema, helping to ensure that your application receives valid data.

---

### 3. Bcrypt

```
from flask_bcrypt import Bcrypt

user_fields = user_schema.load(request.json)
user.username = user_fields["username"]
user.password =
bcrypt.generate_password_hash(user_fields["password"]).decode("utf-8")

db.session.add(user)
db.session.commit()
```

Using Bcrypt extension can take a plain text password and converting it into a hashed value that is difficult to reverse. It helps to protect against common security threats like password cracking and SQL injection.

---

### 4. JWT

```
from flask_jwt_extended import JWTManager
from flask_jwt_extended import create_access_token
from flask_jwt_extended import jwt_required, get_jwt_identity
```

```
jwt = JWTManager()

access_token = create_access_token(identity=str(user.username))
```

```
#Admin delete patient's account
@auth.delete("/user/delete/<int:id>")
@jwt_required()
def delete_user(id):
    user_name = get_jwt_identity()
    user = User.query.filter_by(username=user_name).first()
    if not user:
        return abort(401, description="Invalid user")
    if not user.admin:
        return abort(401, description="Unauthorized user")

    patient = User.query.filter_by(id=id).first()
    if not patient:
        return abort(400, description="Can't find that user")
    if patient.admin:
        return abort(400, description="Can't delete admin account")

    db.session.delete(patient)
    db.session.commit()
    return jsonify({"Patient {} {}".format(x=patient.f_name,
y=patient.l_name): "has been deleted"})
```

We use jwt flask extension to provide JSON Web Token to authenticate and authorize in this app. It provides decorators for easily restricting access to certain endpoints based on the user's permissions.

## 5. datetime and functools

```
from datetime import datetime

@dentist.post("/<int:id>/booking")
@jwt_required()
def book_treatment(id):
    user_name = get_jwt_identity()
    user = User.query.filter_by(username=user_name).first()
    if not user:
        return abort(401, description="Invalid user")
```

```

booking_fields = booking_schema.load(request.json)

dentist = Dentist.query.filter_by(id=id).first()

if not dentist:
    return abort(400, description="dentist not exist")

exist = Booking.query.filter_by(user_id=user.id,
status="Open").first()
if exist:
    return abort(400, description="You already have a open booking in
the system. Before booking a new one, please ensure to cancel any existing
booking in the system.")

data = Booking.query.filter_by(dentist_id=id,
date=booking_fields["date"])

for book in data:
    t1 = datetime.strptime(str(book.time), '%H:%M:%S')
    print(t1)
    t2 = datetime.strptime(booking_fields["time"], '%H:%M:%S')
    print(t2)
    delta = t1 - t2
    sec = delta.total_seconds()
    if abs(sec) < 1800:
        return abort(400, description="This time period is already
book out, please selete another time")

booking = Booking()
booking.date = booking_fields["date"]
booking.time = booking_fields["time"]
if "status" in booking_fields:
    booking.status = booking_fields["status"]
booking.user_id = user.id
booking.dentist_id = id
db.session.add(booking)
db.session.commit()

return jsonify(booking_schema.dump(booking))

```

The basic idea of a patient booking appointment with a dentist is we assumed each appointment time for a specific dentist is 30min. So if 16:00:00 is booked, the time slot between 15:30:01 to 16:00:00 and time slot between 16:00:00 to 16:29:59 is not available for any new bookings. Therefore we need to use "datetime.strptime" to calculate the difference between two booking time.

```

from functools import wraps

def admin_authentication(func):

```

```

@wraps(func)
def wrapper():
    user_username = get_jwt_identity()
    user = User.query.filter_by(username=user_username).first()
    if not user:
        return abort(400, description="Invalid User")

    if not user.admin:
        return abort(400, description="You don't have permission to
access system")

    return func()
return wrapper

#Only admin account can retrieve all user's information
@auth.get("/users")
@jwt_required()
@admin_authentication
def get_user():
    # user_name = get_jwt_identity()
    # user = User.query.filter_by(username=user_name).first()
    # if not user:
    #     return abort(401, description="Invaild user")
    # if not user.admin:
    #     return abort(401, description="Unauthorized User")

    users = User.query.all()
    result = users_schema.dump(users)
    return jsonify(result)

```

I create a decorator here to reduce the repeated admin account authentication code in each Endpoint.

---

## 6. Blueprint

```

from flask import jsonify, Blueprint

auth = Blueprint('auth', __name__, url_prefix='/auth')

```

I use flask Blueprint in this project to break this application into smaller components, each with its own routes, views, and templates. This makes it easier to manage and maintain this application as it grows.

---

## R8. Describe your projects models in terms of the relationships they have with each other

---

There are four Models in this project which are "User", "Dentist", "Booking" and "Treatment".

Based on ERD, "User" and "Dentist" has a many to many relationship. Therefor "Booking" is a new Entity created between them.

Here is "User" Model.

```
from main import db

class User(db.Model):
    __tablename__ = 'users'
    id = db.Column(db.Integer, primary_key=True)
    f_name = db.Column(db.String(), nullable=False)
    l_name = db.Column(db.String(), nullable=False)
    username = db.Column(db.String(), nullable=False, unique=True)
    password = db.Column(db.String(), nullable=False)
    mobile = db.Column(db.String())
    admin = db.Column(db.Boolean(), default=False)

    booking = db.relationship(
        "Booking",
        backref="user",
        cascade="all, delete"
    )
```

From User Model we can see id is the primary key, the only field is nullable is mobile, and the username should be unique. booking = db.relationship indicate the one to many relation between User and Booking Model, and cascade="all, delete" means if you delete one of the user, all the bookings related to this user will be deleted as well.

The admin field in User Model is used for separating the normal patient and Admin. Cause some of the requests like create dentist account or check all patients info is prohibited being used or access by normal user/patients.

Next one is Dentist Model:

```
from main import db

class Dentist(db.Model):
    __tablename__ = 'dentists'
    id = db.Column(db.Integer, primary_key=True)
    f_name = db.Column(db.String(), nullable=False)
    l_name = db.Column(db.String(), nullable=False)
    username = db.Column(db.String(), nullable=False, unique=True)
    password = db.Column(db.String(), nullable=False)
    speciality = db.Column(db.String())

    booking = db.relationship(
        "Booking",
        backref="dentist",
        cascade="all, delete"
    )
```

We can see same as the User Model, Dentist Model has booking = db.relationship too, cause 1 dentist can have many bookings. And if delete one of the dentist account, all the bookings related to him will be deleted as well.

Here is the Booking Model:

```
from main import db

class Booking(db.Model):
    __tablename__ = 'bookings'
    id = db.Column(db.Integer, primary_key=True)
    date = db.Column(db.Date(), nullable=False)
    time = db.Column(db.Time(), nullable=False)
    status = db.Column(db.String(), nullable=False, default="Open")
    user_id = db.Column(db.Integer, db.ForeignKey("users.id"),
    nullable=False)
    dentist_id = db.Column(db.Integer, db.ForeignKey("dentists.id"),
    nullable=False)

    treatment = db.relationship(
        "Treatment",
        backref="booking",
        cascade="all, delete"
    )
```

From Booking Model, we have one foreign key from the User Model, and one foreign key from the Dentist Model, and they can't be null. So one booking must have one user id and one dentist id to represent which user booking an appointment with which dentist. The Booking Model also has a relationship with Treatment Model. One booking can have many treatment under that booking, for example, in one dental booking, we can have "Comprehensive exam" which is charge \$50, we also can have "Full mouth xray" which is charge \$120. Both of them are totally different treatment, but it can happen in one booking.

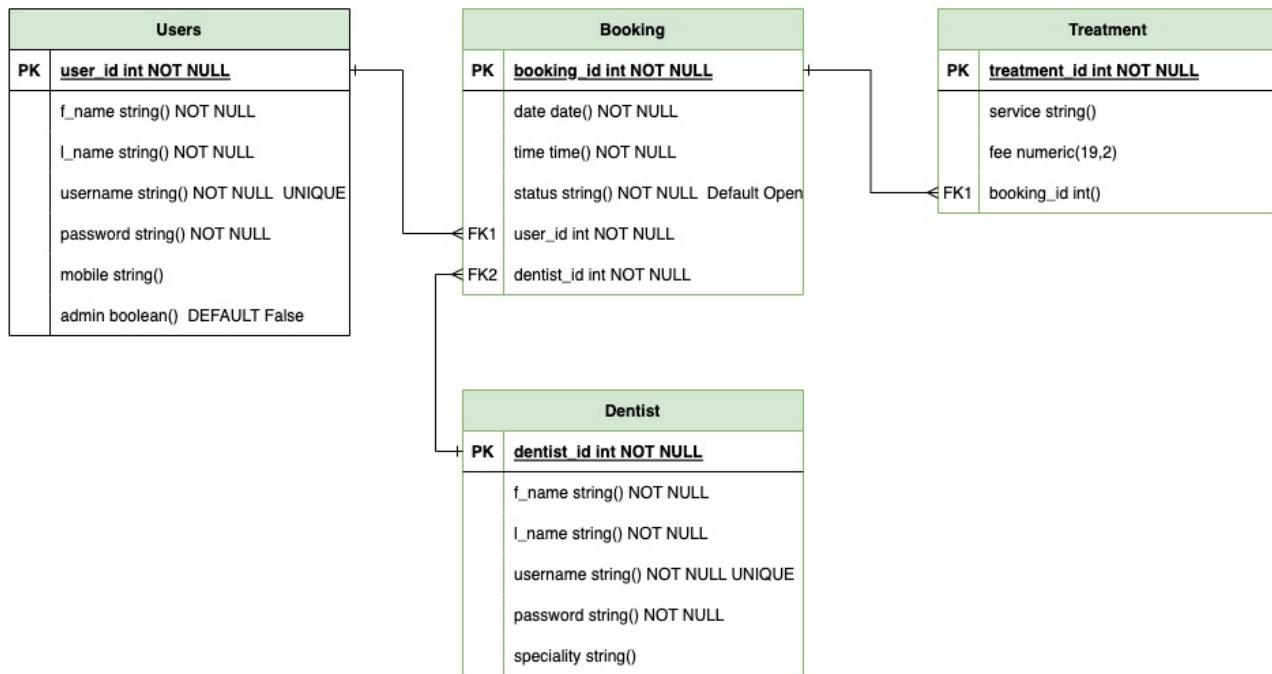
The last one is Treatment Model:

```
from main import db

class Treatment(db.Model):
    __tablename__ = 'treatments'
    id = db.Column(db.Integer, primary_key=True)
    service = db.Column(db.String(), nullable=False)
    fee = db.Column(db.Numeric(10,2), nullable=False)
    booking_id = db.Column(db.Integer, db.ForeignKey("bookings.id"),
    nullable=False)
```

Cause one treatment must belong to one booking, the foreign key used here is for this reason, and it can't be null.

## R9. Discuss the database relations to be implemented in your application



Based on the ERD, there will be 4 tables implemented in this app.

- Users (Patients/Admin)
  - Dentists
  - Bookings
  - Treatments
1. one user can have many bookings
  2. one user can only have one booking with "Open" status
  3. one booking only belongs to one user
  4. one booking only belongs to one dentist
  5. one dentist can have many bookings
  6. one booking can have many treatments
  7. one treatment only belongs to one booking

## R10. Describe the way tasks are allocated and tracked in your project

<https://trello.com/b/9H91Pnzz/project-management>

I use trello as the project management tool, it allows me to organize the tasks and track progress. I devide this project as 4 parts, Project planning(ERD), Model and Schema Creation, Endpoints and documentation, Testing. I set the duo date for each task and remind me when deadlines are approaching. And the checklist in each card helps me to make sure each Endpoints is working properly without errors.