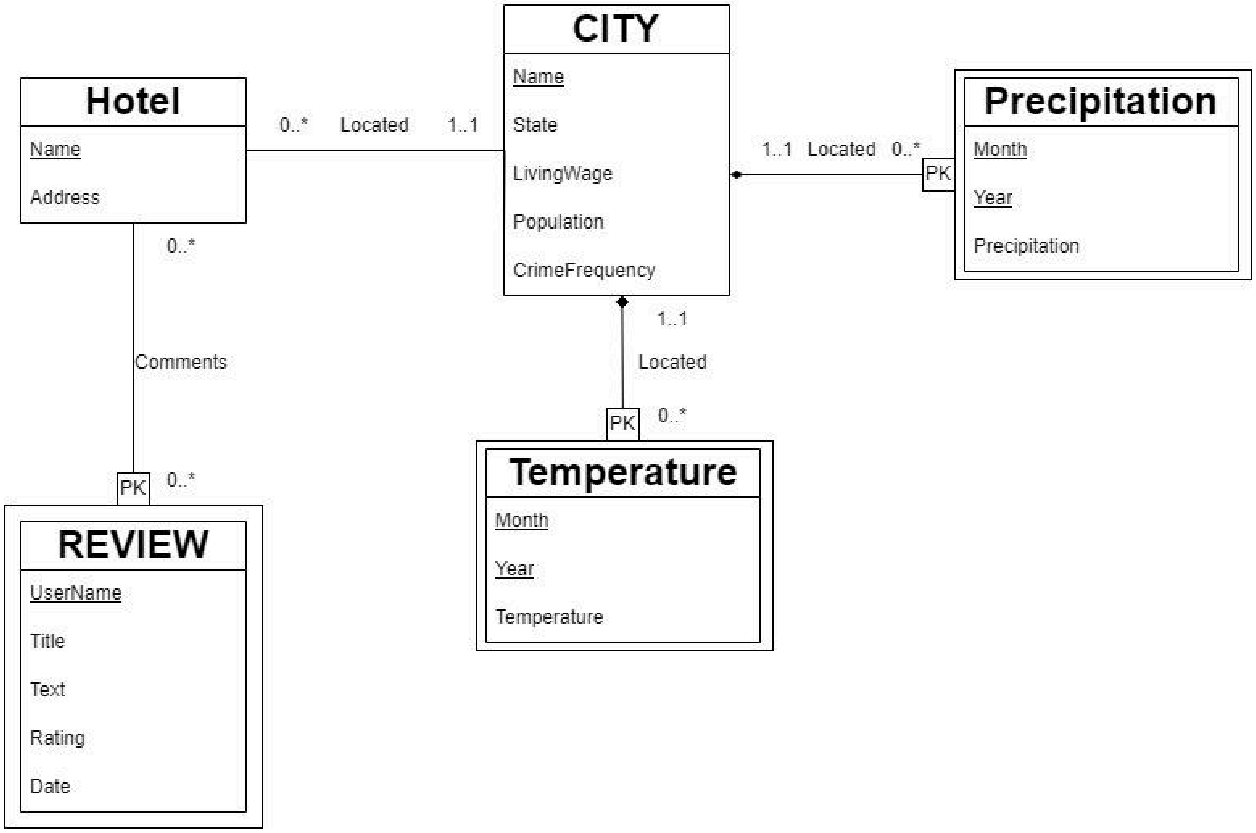
1. UML Diagram:



2. Assumptions:

The database stores information about Hotels, Cities, Reviews, Temperature, and Precipitation.

1. CITY

This is an entity regarding the locations, with 5 attributes about basic information.

(1) Name: The name of the city referred to geographic areas.
The primary key of the entity.
(2) State: The name of state referred to geographic areas
(3) LivingWage: The average of Wage referred to the city
(4) Population: The amount of people referred to the city
(5) CrimeFrequency: The frequency of crime referred to the city

Description:

- A City is uniquely identified by its Name. Other city attributes are State, LivingWage, Population, and CrimeFrequency.

Explanation:

- City deserves to be an entity set since it has at least one non-key attribute.

2. HOTEL

This is an entity regarding the hotels with the address , with 2 attributes.

(1) Name : The name of the hotel given a name designation.
The primary key of the entity.

(2) Address : The location of the hotel referred to geographic areas.

Description:

- A Hotel is uniquely identified by its Name. It has Address as another attribute.

Relationship:

- A City may have multiple Hotels located within it, but a Hotel is located in only one City, which we denote as **1-many relationship**.

Explanation:

- Hotel deserves to be an entity set since it has at least one non-key attribute.

3. REVIEW

This is a weak entity regarding the comments about user experience, with 5 attributes.

(1) UserName: The name of the user given a name designation.
The primary key of the entity.

(2) Title: The title of the comment referred to the hotel.

(3) Text: The content of the comment referred to the user experience.

(4) Rating: The score of the user experience.

(5) Date: The time stamp of the user experience.

Description:

- A Review is uniquely identified by its UserName and the hotel it comments on. Other review attributes are Title, Text , Date and Rating.

Relationship:

- A Hotel may have Reviews by multiple users, and one user can make Reviews on multiple Hotels, which we denote as **many-many relationship**.

Explanation:

- Review deserves to be an entity set since it has at least one non-key attribute.

4. TEMPERATURE

This is a weak entity regarding the average temperature in a city, with 3 attributes.

(1) Month: The month of the average temperature. The primary key of the entity.

(2) Year: The year of the average temperature. The primary key of the entity.

(3) Temperature: The average temperature in a city with the time designation.

Description:

- The Temperature is uniquely identified by Month, Year and the city it locates at. It has Temperature as another attribute.

Relationship:

- A Temperature can only be located at a single City, but a City may have multiple Temperature according to the month and year, which we denote as **1-many relationship**.

Explanation:

- Temperature deserves to be an entity set since it has at least one non-key attribute.

5. PRECIPITATION

This is a weak entity regarding the average precipitation in a state, with 3 attributes.

(1) Month: The month of the average precipitation. The primary key of the entity.
(2) Year: The year of the average precipitation. The primary key of the entity.
(3) Temperature: The average precipitation in a city with the time designation.

Description:

- The Precipitation is uniquely identified by Month, Year and the state it locates at. It has Precipitation as another attribute.

Relationship:

- A Precipitation can only be located at a single state, which belongs to the City, but a City may have multiple Precipitation according to the month and year, which we denote as **1-many relationship**.

Explanation:

- Precipitation deserves to be an entity set since it has at least one non-key attribute.

3. Normalization: (BCNF vs 3NF)

We choose 3rd Normal Form (3NF) since:

- It can eliminate redundancy in the relational schema.
- It can preserve functional dependencies when decomposing.

Functional Dependency

[FD1] HotelName -> Address, CityName
[FD2] UserName, HotelName -> Title, Text, Rating, Date
[FD3] CityName -> State, LivingWage, Population, CrimeFrequency
[FD4] State, Month, Year -> Precipitation
[FD5] CityName, Month, Year -> Temperature

3NF

1. HotelName is a super-key for Hotel.
2. UserName and HotelName compose super-key for Review.
3. CityName is a super-key for City.
4. CityName, Month, Year compose super-key for Precipitation.
5. State, Month, Year compose super-key for Temperature.

4. Relational Schema:

```
1. Hotel(
        Name: VARCHAR(255) [PK],
        Address: VARCHAR(255),
        CityName: VARCHAR(255) [FK to City.Name]
)

2. Review(
        UserName: VARCHAR(255) [PK],
        Title: VARCHAR(255),
        Text: VARCHAR(255)
        Rating: INT,
        Date: VARCHAR(255),
        HotelName: VARCHAR(255) [PK] [FK to Hotel.Name]
)

3. City(
        Name: VARCHAR(255) [PK],
        State: VARCHAR(255),
        LivingWage: REAL,
        Population: INT,
        CrimeFrequency: INT
)

4. Temperature(
        Month: INT [PK],
        Year: INT [PK],
        Temperature: REAL,
        CityName: VARCHAR(255) [PK] [FK to City.Name]
)

5. Precipitation(
        Month: INT [PK],
        Year: INT [PK],
        Precipitation: REAL,
        CityState: VARCHAR(255) [PK] [FK to City.State]
)
```