



The database design adheres to normalization principles up to BCNF (Boyce-Codd Normal Form). Each relation satisfies the BCNF requirements due to the following reasons:

1NF(First Normal Form): Every table contains atomic values, and each column holds unique data types.

2NF (Second Normal Form): All non-key attributes exhibit full functional dependency on the primary key. For instance, in the Rental table, attributes such as date_rented and price rely on the composite primary key rental_id.

3NF (Third Normal Form): Absence of transitive dependencies is observed. For instance, in the Promotion table, the discount_percentage exclusively depends on the primary key promotion_id rather than on class_id.

BCNF: Compliance is maintained since every determinant in the relationships qualifies as a super key. All tables are in BCNF, with no instances of a non-superkey determining another attribute.

Keys and Integrity:

primary Keys (PK): class_id in CarClass, promotion_id in Promotion, rental_id in Rental, car_id in Car, customer_id in Customer, employee_id in Employee. Each primary key uniquely identifies a record in its corresponding table, ensuring entity integrity.

Foreign Keys (FK): class_id in Car references CarClass, class_id in Promotion references CarClass, customer_id and car_id in Rental reference Customer and Car, respectively. These foreign keys uphold referential integrity, guaranteeing valid relationships between tables (e.g., a rental must be associated with a valid customer and car).

Surrogate Keys:

Some tables utilize auto-incrementing integers such as promotion_id and rental_id as surrogate keys. These keys lack real-world significance but are valuable for uniquely identifying records.

LIST OF ENTITIES

CarClass

- **Attributes:**

- class_id (Primary Key)
- class_name
- pricing_1_day
- pricing_1_week
- pricing_2_weeks
- pricing_1_month

- **Relationships:**

- **Related to Car:** A car belongs to one car class.
- **Related to Promotion:** A promotion applies to one car class.

- **Participation & Cardinality:**

- **Participation:** Required for Car and Promotion (every piece that goes under Car or Promotion must link to a class).
- **Cardinality:** Among the relations, One CarClass can be associated with many Cars and Promotions, but a Car or Promotion is related to only one CarClass.

Car

- **Attributes:**

- car_id (Primary Key)
- VIN
- license_plate
- make
- model
- year_made

- color
- class_id (Foreign Key to CarClass)
- **Relationships:**
 - **Related to Rental:** A car can be rented many times.
 - **Related to CarClass:** A car belongs to one car class .
- **Participation & Cardinality:**
- Participation: Required in Rental and CarClass models.
- Cardinality: A car is rented by many rentals, but each rental in separate means one car from the parking. A car may be categorized in a number of ways but it has only one class.

3. Customer

- **Attributes:**
 - customer_id (Primary Key)
 - name
 - address
 - phone_numbers
 - driver_license
 - **Relationships:**
 - **Related to Rental:** A customer makes many rentals
 - **Participation & Cardinality:**
 - Participation: Customer shall be mandatory for rentals (each rental must refer to a particular customer).
 - Cardinality: A customer can rent many cars but a rental car means the involvement of only one customer.
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4. Rental

- **Attributes:**
 - rental_id (Primary Key)
 - customer_id (Foreign Key to Customer)
 - car_id (Foreign Key to Car)
 - location_rented_from (Foreign Key to Location)
 - location_returned_to (Foreign Key to Location)
 - date_rented

- date_returned
- fuel_level
- price
- drop_off_charge
- promotion_id (Foreign Key to Promotion)
- **Relationships:**
 - **Related to Customer:** A rental involves one customer .
 - **Related to Car:** A rental involves one car.
 - **Related to Promotion:** A rental can be associated with a promotion.
 - **Related to Location:** A rental occurs at one location.
- **Participation & Cardinality:**
 - Participation: Required for Customer, Car and Location since every rental must contain these entities.
 - Cardinality: Every rental entails one customer, one car, and one promotion if a car rental firm decides to offer one.

5. Location

- **Attributes:**
 - location_id (Primary Key)
 - street_number
 - city
 - postal_code
- **Relationships:**
 - **Related to Rental:** A location is where rentals happen
 - **Related to Employee:** An employee works at one location
- **Participation & Cardinality:**
 - Participation: Required in Rental and Employee (every rental and every employee must have a location).
 - Cardinality: Many rentals exist in a location, but they can only belong to one location, and so does employees.

6. Promotion

- **Attributes:**
 - promotion_id (Primary Key)
 - class_id (Foreign Key to CarClass)
 - discount_percentage
 - start_date
 - end_date
- **Relationships:**
 - **Related to CarClass:** A promotion is linked to a car class
 - **Related to Rental:** A rental can apply a promotion
- **Participation & Cardinality:**
 - Participation: -two of them are mandatory for rental also, a rental can apply a promotion.
 - Cardinality: One kind of promotion can be used for many rentals, however, each rental can have only one promotion.

7. Employee

- **Attributes:**
 - employee_id (Primary Key)
 - name
 - address
 - phone_numbers
 - driver_license
 - category
 - location_id (Foreign Key to Location)
- **Relationships:**
 - **Related to Location:** An employee works at a location .
- **Participation & Cardinality:**

- Participation: Compulsory for Location (an employee has to be placed on a location).
- Cardinality: An employee can be affiliated to a location and yet; the location has many employees.