



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.
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## 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.

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## 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.

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## 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.