Project Specifications

1. **Items**:
    - Represents the various items available in the library or rental system.
    - Fields:
        - **ItemID**: A unique identifier for each item.
        - **Type**: The type or category of the item (could be a book, CD, DVD, etc.).
        - **Title**: The title of the item.
        - **AuthorArtist**: The author of a book or the artist of a CD/DVD.
        - **PublicationYear**: The year when the item was published or released.
        - **Genre**: Genre of the item (like fiction, non-fiction, rock, classical, etc.).
        - **Availability**: Status to denote if the item is available for borrowing.
        - **Stock**: The number of copies of the item available.
2. **Customers**:
    - Represents the library or system's customers.
    - Fields:
        - **CustomerID**: A unique identifier for each customer.
        - **Name**: Name of the customer.
        - **NumberOfLoans**: Total number of items a customer has borrowed.
        - **Balance**: Could be the balance of any unpaid dues or charges.
3. **Loans**:
    - Represents the loans or borrowings of items by customers.
    - Fields:
        - **LoanID**: Unique identifier for each loan transaction.

- **CustomerID**: The ID of the customer borrowing the item.
- **ItemID**: The ID of the item being borrowed.
- **LoanDate**: Date when the item was borrowed.
- **DueDate**: Date when the item is expected to be returned.
- **ReturnDate**: Actual date when the item was returned.
- Fee for late return is calculated based on the number of months the book is late for and deducted from Customer's balance.

4. **Employees**:
    - Represents the employees of the library or rental system.
    - Fields:
        - **EmployeeID**: A unique identifier for each employee.
        - **Name**: Name of the employee.
        - **Type**: Type of employment, which can either be "Paid" or "Volunteering".
5. **Events**:
    - Represents events organized by the library or system.
    - Fields:
        - **EventID**: A unique identifier for each event.
        - **EmployeeID**: The ID of the employee organizing or responsible for the event.
        - **RoomNumber**: Room or location where the event will be held.
        - **Name**: Name or title of the event.
        - **Audience**: Target audience for the event.
        - **Price**: Cost of attending the event.
        - The cost of the event is deducted from customer's balance.
        - **Number_of_Attendees**: Total number of attendees for the event.
        - **MAX_Attendees**: Maximum allowed number of attendees for the event.

6. **FutureItems**:
    - Represents items that the library or system plans to acquire in the future.
    - Fields:
        - **F_ItemID**: A unique identifier for each future item.
        - Most other fields are similar to the "Items" table, with the addition of **AvailabilityDate**, which denotes when the item will be available.
7. **Queries**:
    - Represents queries or concerns raised by customers to the staff.
    - Fields:
        - **QueryID**: A unique identifier for each query.
        - **CustomerID**: The ID of the customer raising the query.
        - **QueryText**: The text or description of the query.
        - **EmployeeID**: The ID of the employee addressing the query.
        - **Status**: The status of the query, either "Resolved" or "Unresolved".

A library database has specific needs and requirements to ensure smooth operations, cataloging, and user satisfaction. Let's break down the essential needs and requirements for a library database in simple terms:

1. **Cataloging Items**:
    - **Need**: Keep track of all items (books, magazines, DVDs, etc.).
    - **Simple Specification**: A list of all books and things with details like title, author, and publication year.
2. **Tracking Availability**:
    - **Need**: Know which items are available or checked out.
    - **Simple Specification**: A status for each item like "available" and "checked out".

3. **Managing Members**:
    - **Need**: Register and manage library members.
    - **Simple Specification**: A list of all people using the library with all needed information about them.
4. **Loan Management**:
    - **Need**: Monitor items borrowed by members, when they're due back, and any late fees.
    - **Simple Specification**: A record of which person took which book, when they took it, and when they should bring it back.
5. **Search Capability**:
    - **Need**: Help members and staff find items quickly.
    - **Simple Specification**: A search box to type in and find books or items by their title, author, or other details.
6. **Events and Classes**:
    - **Need**: Organize and schedule events or classes at the library.
    - **Simple Specification**: A calendar showing different events happening in the library.
7. **Employee Management**:
    - **Need**: Keep track of library staff and information about them.
    - **Simple Specification**: A list of all library workers
8. **Member Queries and Feedback**:
    - **Need**: Allow members to ask questions.
    - **Simple Specification**: A form for members to write questions and receive answers from library staff.
9. **Future Acquisitions**:
    - **Need**: Plan and keep track of items the library wants to buy or add in the future.
    - **Simple Specification**: A wishlist of books or items the library plans to get.

10. **Fine and Payment Management**:
    - **Need**: Manage any fines for late returns and collect payments.
    - **Simple Specification**: A record of any money a member owes for late returns and a way for them to pay.

Entity-relationship model and diagram

For the given database, I'll outline the main entities and their relationships.

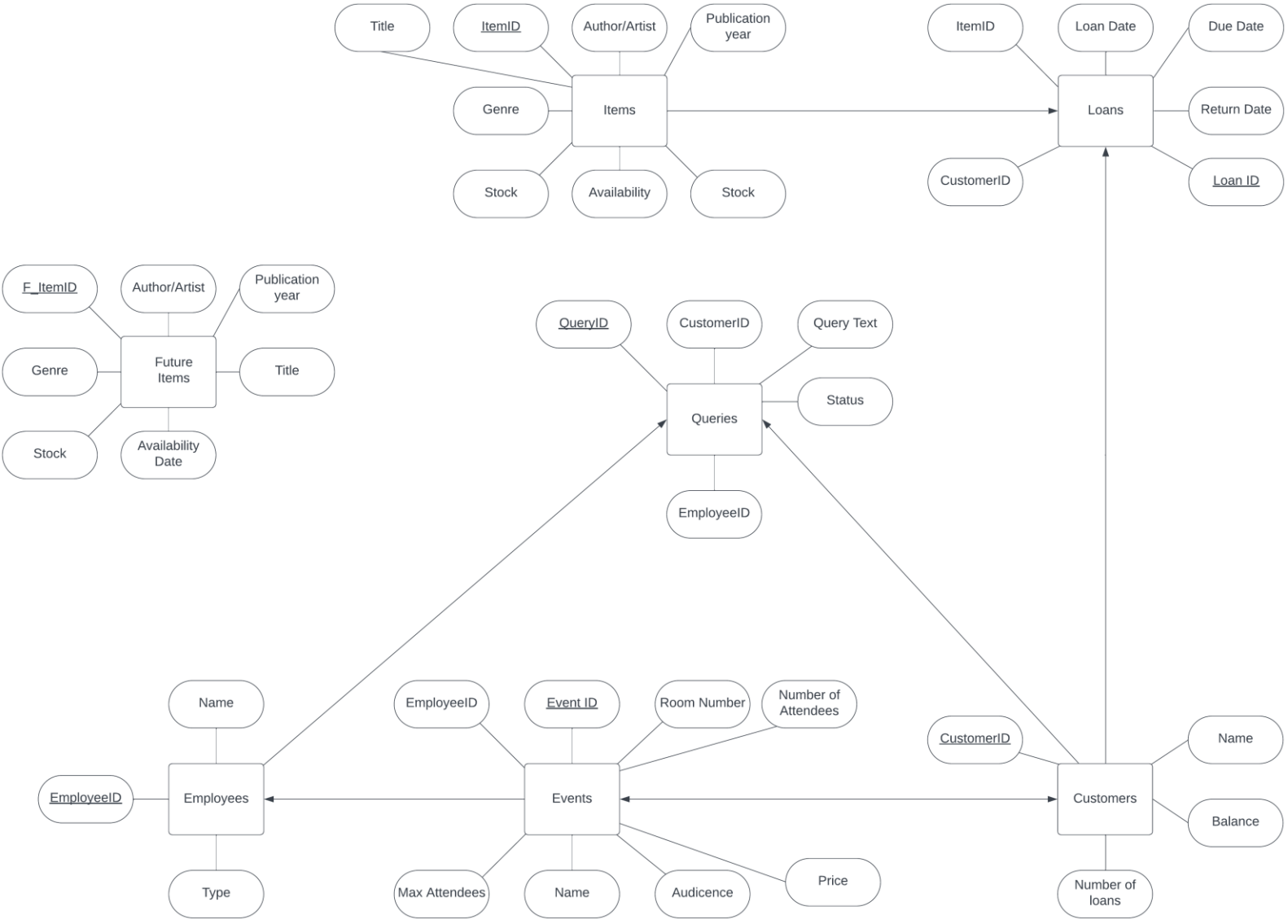
Entities:

1. **Items**
    - Attributes: ItemID, Type, Title, AuthorArtist, PublicationYear, Genre, Availability, Stock
2. **Customers**
    - Attributes: CustomerID, Name, NumberOfLoans, Balance
3. **Loans**
    - Attributes: LoanID, CustomerID, ItemID, LoanDate, DueDate, ReturnDate
4. **Employees**
    - Attributes: EmployeeID, Name, Type
5. **Events**
    - Attributes: EventID, EmployeeID, RoomNumber, Name, Audience, Price, Number_of_Attendees, MAX_Attendees
6. **FutureItems**
    - Attributes: F_ItemID, Type, Title, AuthorArtist, PublicationYear, Genre, AvailabilityDate, Stock
7. **Queries**
    - Attributes: QueryID, CustomerID, QueryText, EmployeeID, Status

Relationships:

1. **Loans-Customers**: One-to-Many from Customers to Loans.
    - A customer can have many loans, but each loan is associated with one customer.
    - Foreign Key: **CustomerID** in Loans references **CustomerID** in Customers.

2. **Loans-Items**: One-to-Many from Items to Loans.
    - An item can be part of many loans (over time), but each loan refers to one item.
    - Foreign Key: **ItemID** in Loans references **ItemID** in Items.
3. **Events-Employees**: Many-to-One from Events to Employees.
    - Many events can be organized or overseen by one employee, but each event is associated with one employee.
    - Foreign Key: **EmployeeID** in Events references **EmployeeID** in Employees.
4. **Queries-Customers**: One-to-Many from Customers to Queries.
    - A customer can raise many queries, but each query is raised by one customer.
    - Foreign Key: **CustomerID** in Queries references **CustomerID** in Customers.
5. **Queries-Employees**: One-to-Many from Employees to Queries.
    - An employee can address many queries, but each query is addressed by one employee.
    - Foreign Key: **EmployeeID** in Queries references **EmployeeID** in Employees.
6. **Events-Customers**: Many-to-Many from Events to Customers.
    - A customer can attend many events, and each event is visited by many customers.


Title
ItemID
Author/Artist
Publication year
Genre
Items
Stock
Availability
Stock
ItemID
Loan Date
Due Date
Loans
Return Date
CustomerID
Loan ID
F_ItemID
Author/Artist
Publication year
Genre
Future Items
Title
Stock
Availability Date
QueryID
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Name
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Type
EmployeeID
Event ID
Room Number
Number of Attendees
Events
Max Attendees
Name
Audicence
Price
CustomerID
Name
Customers
Balance
Number of loans

Anomalies

Identifying Functional Dependencies (FDs):

1. **Items**:
    - **ItemID → Type, Title, AuthorArtist, PublicationYear, Genre, Availability, Stock**
        - This suggests that the **ItemID** uniquely determines all other attributes in the table.
2. **Customers**:
    - **CustomerID → Name, NumberOfLoans, Balance**
        - The **CustomerID** uniquely determines the name, number of loans, and balance of the customer.
3. **Loans**:
    - **LoanID → CustomerID, ItemID, LoanDate, DueDate, ReturnDate**
        - Each loan has a unique **LoanID** that determines the details of the loan.
    - Note: There isn't a direct functional dependency between **CustomerID** and **ItemID** because a customer can borrow many items and an item can be borrowed by many customers over time.
4. **Employees**:
    - **EmployeeID → Name, Type**
        - The **EmployeeID** uniquely determines the name and type of the employee.
5. **Events**:
    - **EventID → EmployeeID, RoomNumber, Name, Audience, Price, Number_of_Attendees, MAX_Attendees**
        - The **EventID** determines all details of an event.
6. **FutureItems**:
    - **F_ItemID → Type, Title, AuthorArtist, PublicationYear, Genre, AvailabilityDate, Stock**

- Similar to Items, the **F_ItemID** uniquely identifies upcoming items.

7. **Queries**:
    - **QueryID → CustomerID, QueryText, EmployeeID, Status**
        - Each query can be uniquely identified using the **QueryID**.

Checking BCNF:

For a table to be in BCNF:

1. It must be in 3NF.
2. For every non-trivial functional dependency $X \rightarrow Y$, X should be a superkey.

By examining the FDs for each table, we see that the left side of every FD (like **ItemID**, **CustomerID**, **LoanID**, etc.) is indeed a superkey for their respective tables. Therefore, the design appears to be in BCNF.

Proving No Bad FDs:

To prove that there are no bad functional dependencies, we should ensure:

1. No partial dependencies: No attribute is functionally dependent on a part of a primary key. Given that all our tables with composite keys (like **Loans**) don't have attributes depending solely on a part of the key, we can confirm there are no partial dependencies.
2. No transitive dependencies: Non-key attributes shouldn't determine other non-key attributes. By examining the tables, we don't see such dependencies, which means there are no transitive dependencies.