**Assignment 1**

**Analyze a given business scenario and create an ER diagram that includes entities, relationships, attributes, and cardinality. Ensure that the diagram reflects proper normalization up to the third normal form.**

**Business Scenario**

Let's consider a library management system. The library wants to track the following:

* Books: Each book has a unique ISBN, title, publication year, and genre.
* Authors: Each author has a unique ID, name, and biography.
* Members: Each member has a unique ID, name, address, phone number, and membership date.
* Borrowing Transactions: Each borrowing transaction involves a member borrowing a book on a specific date, with an expected return date and an actual return date.
* Publishers: Each publisher has a unique ID, name, and contact information.
* Books-Publishers Relationship: Each book is published by a single publisher but a publisher can publish many books.
* Books-Authors Relationship: Each book can have multiple authors and each author can write multiple books.

**Entities and Attributes**

1. **Books**

* ISBN (Primary Key)
* Title
* Publication Year
* Genre
* Publisher ID (Foreign Key)

1. **Authors**

* Author ID (Primary Key)
* Name
* Biography

1. **Members**

* Member ID (Primary Key)
* Name
* Address
* Phone Number
* Membership Date

1. **Borrowing Transactions**

* Transaction ID (Primary Key)
* Member ID (Foreign Key)
* ISBN (Foreign Key)
* Borrow Date
* Expected Return Date
* Actual Return Date

1. **Publishers**

* Publisher ID (Primary Key)
* Name
* Contact Information

1. **Books-Authors (Associative Entity)**

* ISBN (Foreign Key)
* Author ID (Foreign Key)

**Relationships and Cardinality**

1. Books to Publishers: One-to-Many (One publisher can publish many books, but each book has only one publisher).
2. Books to Authors: Many-to-Many (Each book can have multiple authors, and each author can write multiple books).
3. Books to Borrowing Transactions: One-to-Many (Each book can have many borrowing transactions, but each transaction is for one book).
4. Members to Borrowing Transactions: One-to-Many (Each member can have many borrowing transactions, but each transaction is by one member).

**ER Diagram**

Below is the description of the ER diagram. Due to the text-based medium, I'll describe the structure, but you can visualize it using any ER diagram tool like draw.io, Lucidchart, or even on paper.

**ER Diagram Structure:**

1. **Books**

* ISBN (PK)
* Title
* Publication Year
* Genre
* Publisher ID (FK)

1. **Authors**

* Author ID (PK)
* Name
* Biography

1. **Members**

* Member ID (PK)
* Name
* Address
* Phone Number
* Membership Date

1. **Borrowing Transactions**

* Transaction ID (PK)
* Member ID (FK)
* ISBN (FK)
* Borrow Date
* Expected Return Date
* Actual Return Date

1. Publishers

* Publisher ID (PK)
* Name
* Contact Information

1. Books-Authors

* ISBN (FK)
* Author ID (FK)

**Relationships:**

1. Books to Publishers:

* One-to-Many: Books (Publisher ID) -> Publishers (Publisher ID)

1. Books to Authors:

* Many-to-Many: Books-Authors (ISBN, Author ID) -> Books (ISBN)
* Many-to-Many: Books-Authors (ISBN, Author ID) -> Authors (Author ID)

1. Books to Borrowing Transactions:

* One-to-Many: Borrowing Transactions (ISBN) -> Books (ISBN)

1. Members to Borrowing Transactions:

* One-to-Many: Borrowing Transactions (Member ID) -> Members (Member ID)

**Normalization up to 3NF**

* 1NF: Each table has atomic values and a unique identifier (Primary Key).
* 2NF: Each non-key attribute is fully functional dependent on the primary key.
* 3NF: There are no transitive dependencies (non-key attributes do not depend on other non-key attributes).

By ensuring each entity and relationship adheres to the above rules, the database is normalized up to the third normal form.