System Design: Library Management System

1. **Overview:** A Library Management System modeling the complete lifecycle of books, including state transitions and relationships with categories, authors, members, and library management.

2. **Entities & Attributes**

   Books
   - book_id (PK), title, isbn, category_id (FK)
   - current_state: Available | Reserved | Borrowed | Under Maintenance | Lost

   Category
   - category_id (PK), category_name

   Author
   - author_id (PK), author_name

   Member
   - member_id (PK), name, email, membership_type

   Library
   - library_id (PK), library_name, location

3. **Book State Definitions**

State	Description
Available	Ready to be borrowed or reserved
Reserved	Held for a specific member
Borrowed	Checked out by a member
Under Maintenance	Being repaired or reviewed
Lost	Reported missing

4. **State Transitions**

Current State	Action	Next State	Actor
Available	Member reserves	Reserved	Member
Available	Member borrows directly	Borrowed	Member
Available	Sent for	Under Maintenance	Librarian

	maintenance		
Reserved	Reserved member borrows	Borrowed	Member
Reserved	Reservation cancelled	Available	System/Member
Borrowed	Member returns	Available	Librarian
Borrowed	Reported lost	Lost	Librarian
Borrowed	Sent for maintenance	Under Maintenance	Librarian
Under Maintenance	Maintenance complete	Available	Librarian
Lost	Book found	Available	Librarian

5. **Entity Relationships**
    - **Library** → **Book:** One-to-Many (1 library manages many books)
    - **Book** → **Category:** Many-to-One (each book has 1 category)
    - **Book** ↔ **Author:** Many-to-Many (books have multiple authors)
    - **Book** ↔ **Member:** Many-to-Many (members borrow/reserve multiple books)

6. **Example Workflow**
    - **Book Added** → **State**: Available
    - **John reserves** → **State**: Reserved
    - **John borrows the book** → **State**: Borrowed
    - **John returns the book** → **State**: Available
    - **Book damaged** → **State**: Under Maintenance
    - **Repair completed** → **State**: Available

7. **Conclusion**
   This system design provides a model for managing book lifecycles in a library, ensuring efficient tracking of availability, reservations, borrowing, maintenance, and loss scenarios while maintaining clear relationships between all entities.