Project Part 4: The Logical Relational Model

Tej Gumaste, Jay Patel, Shayaan Mohammed, Kaleb Howard,
Andrew Reyes, James Hanselmann

Introduction

Project Overview

Our Library Database System is designed to aid in inventory management, enhance resource tracking, and improve accessibility for library patrons and administrators. This system will track books, research articles, and technical equipment, maintaining efficient management of library resources. Additionally, it will be capable of generating reports that provide insights into inventory usage, overdue items, and borrowing patterns, making information retrieval and analysis easy. The database will also facilitate secure transactions, user authentication, and overdue fee management, ensuring smooth library operations.

Scope

The scope of our Library Database System includes inventory management, item tracking, technology checkouts, and overdue fees management. The system will monitor all library resources, track item checkouts and returns, and maintain records of overdue items. It will support various user roles such as students, faculty, administrators, and residents, ensuring secure access to resources. Along with that, the system will also generate analytical reports that help administrators manage library operations efficiently.

Glossary

- **User**: Any individual accessing the library database, including students, faculty, and administrators.
- **ISBN**: International Standard Book Number, a unique identifier for books.
- **DOI**: Digital Object Identifier, a unique alphanumeric string assigned to digital articles.
- **Transaction**: A record of an item being checked out or returned.
- **Overdue Fees**: Fines applied to users for not returning items within the due date.
- **Entity**: A distinct object in the database, such as a book, article, or user.
- **Attribute**: A property or characteristic of an entity, such as a book's title or an article's author.
- **Multiplicity**: Defines the relationship between entities (e.g., one-to-many, many-to-many).

Relational Schema Mapping

Identify Relations

User
Attributes:

- OnlineID (PK): INT
- StudentFacultyID: VARCHAR(20)
- Name: VARCHAR(100)
- Email: VARCHAR(100)
- UserType: ENUM('student', 'faculty', 'admin')
- Payment: DECIMAL(10,2)
- BorrowingHistory: TEXT

Books
Attributes:

- ISBN (PK): VARCHAR(13)
- Title: VARCHAR(255)
- Author: VARCHAR(255)
- YearReleased: YEAR
- Type: ENUM('fiction', 'non-fiction', 'academic', etc.)
- Storage: ENUM('digital', 'physical_shelf', 'back_office', etc.)
- Status: ENUM('available', 'checked_out', 'out_of_stock')
- ReturnDate: DATE

Articles
Attributes: Composite Key (Title, Author)

- Title (PK1): VARCHAR(255)
- Author (PK2): VARCHAR(255)
- Status: ENUM('available', 'checked_out', 'out_of_stock')
- FieldOfStudy: VARCHAR(100)
- JournalName: VARCHAR(255)
- YearPublished: YEAR
- DOI: VARCHAR(50)
- ReturnDate: DATE
- Storage: ENUM('digital', 'physical_shelf', etc.)

Technology
Attributes:

- SerialNumber (PK): VARCHAR(50)
- Type: ENUM('laptop', 'charger')
- Status: ENUM('available', 'checked_out', 'out_of_stock')
- ReturnDate: DATE
- LicenseDuration: DATE RANGE

Transactions
Attributes:

- TransactionID (PK): INT
- UserID (FK → User.OnlineID): INT
- ItemID: VARCHAR(50)
- ItemType: ENUM('book', 'article', 'technology')
- TransactionType: ENUM('checkout', 'return', 'extension_request')
- DueDate: DATE
- Timestamp: DATETIME

Copy
Attributes:

- CopyID (PK): INT
- ISBN (FK → Books.ISBN): VARCHAR(13)
- Status: ENUM('available', 'checked_out')
- ReturnDate: DATE

Relationship	Entity	Attribute
Makes	User → Transaction	User_ID
		Transaction_ID
Includes	Transaction → {Book, Article, Technology}	Transaction_ID
		ISBN

		Article_ID
		serial_no
Is	Copy → Book	Copy_ID
		ISBN

Define Attributes and Domains
Refer to the Data Dictionary

Determine Primary Keys

Relationships	**Entities**	**Primary Key**
Makes	User → Transaction	transaction_id
Includes	Transaction → {Book, Article, Technology}	transaction_id
Is	Copy → Book	copy_id

Establish Foreign Keys

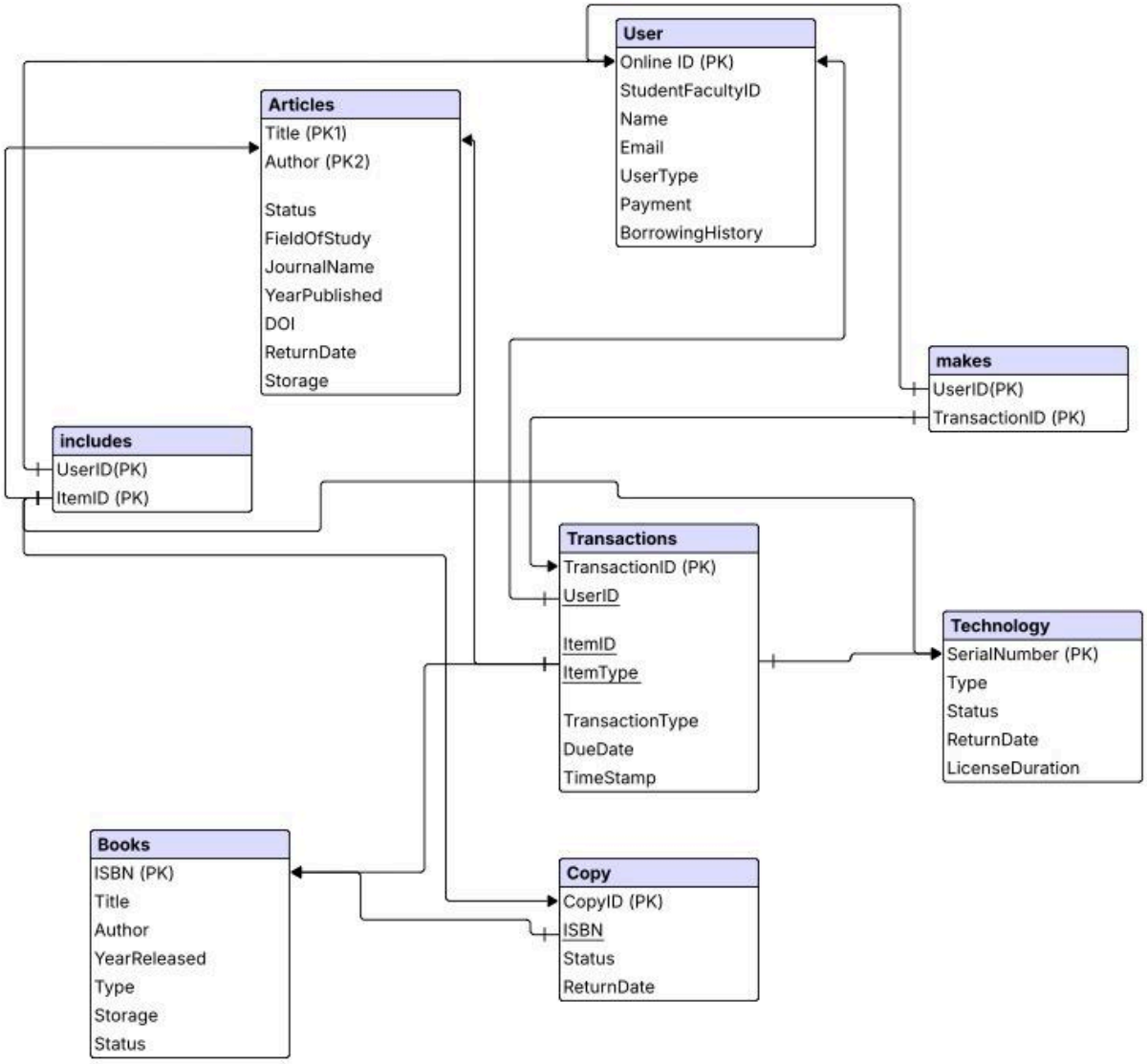
Relationship	**Entities**	**Foreign Key Mapping**
Makes	User → Transaction	User_ID → User.Online_ID, Transaction_ID → Transaction.Transaction_ID
Includes	Transaction → Book	ISBN → Book.ISBN, Transaction_ID →

		Transaction.Transaction_ID
Includes	Transaction → Article	Article_ID → Article.Article_ID, Transaction_ID → Transaction.Transaction_ID
Includes	Transaction → Technology	serial_no → Technology.serial_no, Transaction_ID → Transaction.Transaction_ID
Is	Copy → Book	ISBN → Book.ISBN

Establish Functional Dependencies

Relationship	**Entities**	**Functional Dependency**
Makes	User → Transaction	TBD
Includes	Transaction → Book	TBD
Includes	Transaction → Article	TBD
Includes	Transaction → Technology	TBD
Is	Copy → Book	TBD

Relational Schema Diagram



Schema Documentation with a Data Dictionary

Entity	Attribute	Data Type	Description
User	Online ID (PK)	INT	Unique identifier for each user.
	Student/Faculty ID	VARCHAR(20)	University-issued identification.
	Name	VARCHAR(100)	Full name of the user.
	Email	VARCHAR(100)	University email address.

	User Type	ENUM(‘student’, ‘faculty’, ‘admin’)	Role of the user.
	Payment	DECIMAL(10,2)	Outstanding fines or balances.
	Borrowing History	TEXT	Log of past transactions.
Books	ISBN (PK)	VARCHAR(13)	Unique 13-digit book identifier.
	Title	VARCHAR(255)	Name of the book
	Author	VARCHAR(255)	Name of author(s).
	Year Released	YEAR	Year of publication.
	Type	ENUM(‘fiction’, ‘non-fiction’, ‘academic’, etc.)	Category of the book.
	Storage	ENUM(‘digital’, ‘physical_shelf’, ‘back_office’, etc.)	Storage location
	Status	ENUM(‘available’, ‘checked_out’, ‘out_of_stock’)	Availability status
	Return Date	DATE	Due date if checked out.
Articles	Title (PK)	VARCHAR(255)	Title of the article.
	Author (PK)	VARCHAR(255)	Name of author(s).
	Status	ENUM(‘available’, ‘checked_out’, ‘out_of_stock’)	Availability status.
	Field of Study	VARCHAR(100)	General discipline (e.g., Physics).
	Journal Name	VARCHAR(255)	Name of the journal
	Year Published	YEAR	Year of publication.
	DOI	VARCHAR(50)	Unique identifier for digital articles.
	Return Date	DATE	Due date if checked out.

	Storage	ENUM(‘digital’, ‘physical_shelf’, etc.)	Storage location
Technology	Serial Number (PK)	VARCHAR(50)	Unique identifier for tech items.
	Type	ENUM(‘laptop’, ‘charger’)	Type of tech item.
	Status	ENUM(‘available’, ‘checked_out’, ‘out_of_stock’)	Availability status.
	Return Date	DATE	Due date if checked out.
	License Duration	DATE RANGE	Software license period.
Transactions	Transaction ID (PK)	INT	Unique transaction identifier.
	User ID (FK)	INT	References User(Online ID).
	Item ID (FK)	VARCHAR(50)	References Books, Articles, or Technology.
	Item Type	ENUM(‘book’, ‘article’, ‘technology’)	Type of item involved.
	Transaction Type	ENUM(‘checkout’, ‘return’, ‘extension_request’)	Nature of transaction.
	Due Date	DATE	Expected return date.
	Timestamp	DATETIME	When the transaction was recorded.
Copy	Status	ENUM(‘available’, ‘checked_out’, etc.)	Availability of the book copy.
	Return Date	DATE	Due date if checked out.
	Copy ID (PK)	INT	Unique identifier for each book copy.
	ISBN (FK)	VARCHAR(13)	References Books(ISBN)