

## Introduction:

### - Project Overview:

- This database's purpose is to simplify the management of a modern library system's core operations. Core operations include resource cataloging, client interactions, and transaction workflows. The entities integrated into the database are books, digital media, clients, staff, and membership types to allow for actions such as borrowing, reservations, and notifications. This system will track these actions, calculate fines, and monitor the availability of physical and digital resources. Relationships between entities ensure seamless coordination, like linking clients to their transactions or reservations, staff to system management, and membership types to borrowing privileges. The database supports real-time updates for availability, automated overdue notifications, and dynamic fine calculations, which align with the library's goals of accessibility, accuracy, and user satisfaction.

### - Scope:

- The scope of this database will cover resource management, client management, transaction workflows, notifications, and staff operations. Resource management will involve cataloging books and digital media with metadata and tracking availability. Client management will involve storing client details, membership types, and account statuses, with borrowing limits tied to membership tiers. Transactional workflows will involve managing checkouts, returns, reservations, and fines, with automated status updates. Notifications will be sent out for due dates, overdue items, and reservation availability. And lastly, staff operations will involve recording staff contact details for internal management. The information that is out of scope is integration with external e-book platforms, mobile app interfaces, payment processing for fine, advanced analytics or predictive modeling for inventory, and inter-library loan systems beyond the local branch network. The system serves as a foundational tool for daily operations, with scalability for future enhancements like API expansions.

### - Glossary:

- Book\_ID/Media\_ID/Magazine\_ID: Unique numeric identifier for physical/digital resources.
- Title: Title of a book/digital media.
- Author/Creator: The person who made the book/digital media.
- Issue\_Number: Specific number assigned to a magazine issue.
- Publish\_Date: The publication date of a magazine issue.
- Genre: Genre of a book/digital media.
- Publication\_Year: Year that a book/digital media was published.
- Format: Type of digital media.
- ISBN: Unique identifier used to identify a book or other publication.
- ENUM: Enumerated data type.
- VARCHAR: Variable-length character string.
- Material\_ID: Foreign key identifier used for identifying a book or digital media.
- Client\_ID: Unique identifier for library clients, linked to transactions and reservations.
- Name: Name of each client.
- DOB: Date of birth.
- Contact\_Info: Contact information of the clients.
- Work\_Phone\_Number: Phone number of those on staff.
- Work\_Email: Email address of those on staff.
- Membership\_Type: Tier (Regular, Student, Senior) determining borrowing limits and fees.
- Transaction\_ID: Unique identifier for a checkout-return event/tied to fines.
- Reservation\_ID: Identifier for holds placed on unavailable items.
- Reservation\_Date: The date of the reservation.
- Reserving\_Limit: Maximum reservations that a client can book.
- Availability\_Status: Current state of a resource (Available/Checked Out/ Reserved).
- Return\_Date: The date that the book/digital media was returned.
- Due\_Date: The date that the book/digital media HAS to be returned.
- Borrowing\_Limit: Maximum items a client can borrow based on their membership
- Borrow\_Date: The date that the book/digital media is borrowed.
- Fine\_Amount: The amount of any fine that is charged for either returning the book/digital media late or losing/destroying the book/digital media.

- Late\_Fee\_Rate: The fee per day for overdue items is defined by membership type.
- OPAC: Online catalog for clients to search resources (implied by
- Title/Author attributes).
- Hold: Synonym for reservations (active, fulfilled, or canceled).
- Staff\_ID: Unique identifier for library employees.
- Notification\_ID: A unique identifier is used to identify notifications.
- Message: The message in the notification sent to the client.
- Sent\_Date: The date that the notification got sent on.
- Account\_Status: Shows whether a client's account is active or not.
- Status: Tracks the status of a reservation

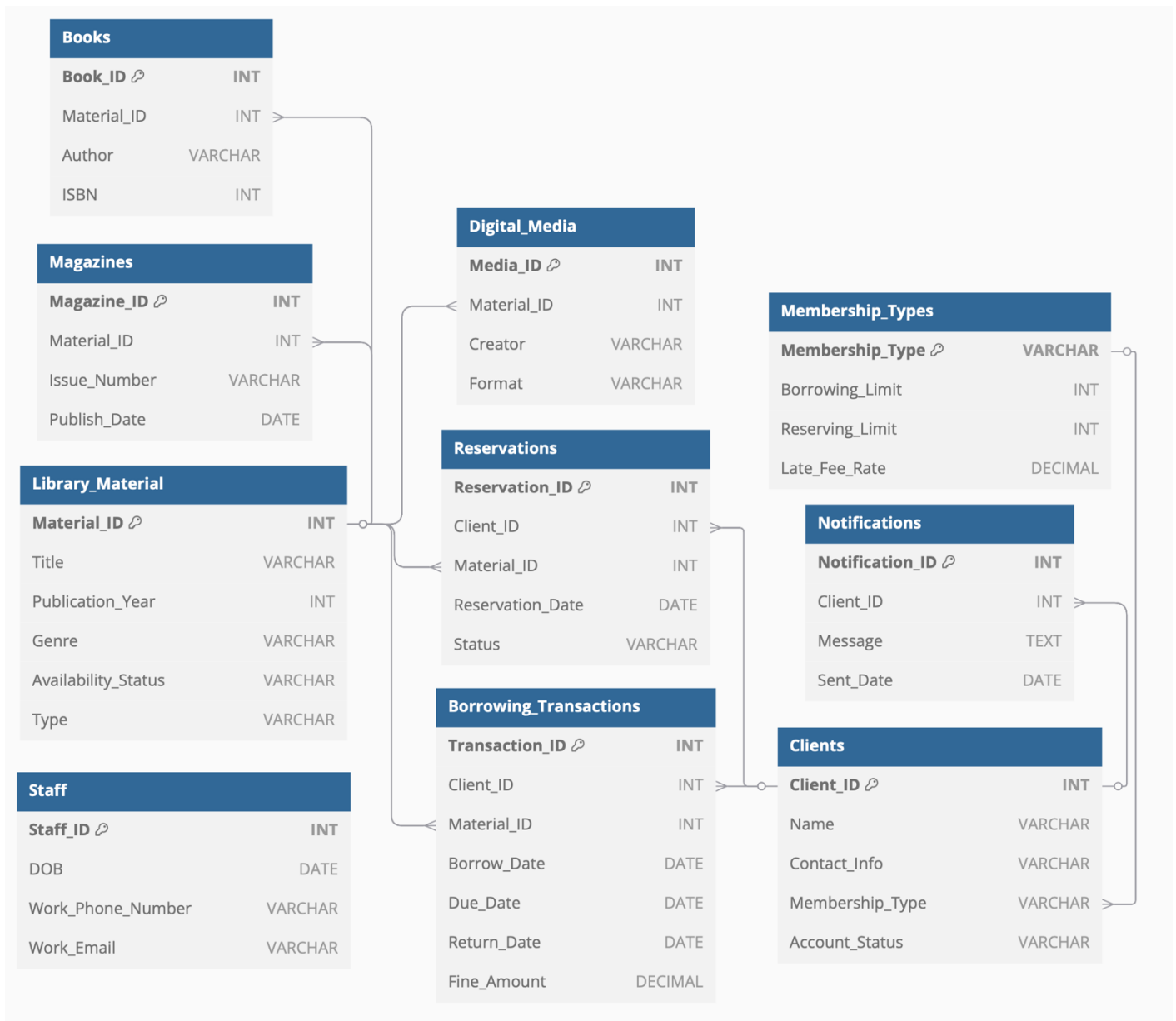
#### Relational Schema Mapping:

- Identify relations:
  - Library\_Material
    - Material\_ID (PK)
    - Title
    - Publication\_Year
    - Genre
    - Availability\_Status
    - Type (ENUM: 'Book', 'Digital Media', 'Magazine')
  - Books
    - Book\_ID (PK)
    - Material\_ID (FK → Library\_Material)
    - Author
    - ISBN (UNIQUE)
  - Digital\_Media
    - Media\_ID (PK)
    - Material\_ID (FK → Library\_Material)
    - Creator
    - Format (ENUM: 'eBook', 'Audiobook', 'DVD', ...)
  - Magazines
    - Magazine\_ID (PK)
    - Material\_ID (FK → Library\_Material)
    - Issue\_Number
    - Publish\_Date
  - Clients
    - Client\_ID (PK)

- Name
  - Contact\_Info
  - Membership\_Type (FK → Membership\_Types)
  - Account\_Status (ENUM: 'Active', 'Suspended')
- Staff
  - Staff\_ID (PK, FK → Clients)
  - DOB
  - Work\_Phone\_Number
  - Work\_Email
- Membership\_Types
  - Membership\_Type (PK) (ENUM: 'Regular', 'Student', 'Senior Citizen')
  - Borrowing\_Limit
  - Reserving\_Limit
  - Late\_Fee\_Rate
- Borrowing\_Transactions
  - Transaction\_ID (PK)
  - Client\_ID (FK → Clients)
  - Material\_ID (FK → Library\_Material)
  - Borrow\_Date
  - Due\_Date
  - Return\_Date
  - Fine\_Amount
- Reservations
  - Reservation\_ID (PK)
  - Client\_ID (FK → Clients)
  - Material\_ID (FK → Library\_Material)
  - Reservation\_Date
  - Status (ENUM: 'Active', 'Fulfilled', 'Cancelled')
- Notifications
  - Notification\_ID (PK)
  - Client\_ID (FK → Clients)
  - Message
  - Sent\_Date
- Primary Keys & Foreign Keys:
  - Primary Keys:
    - Books(Book\_ID)
    - Digital\_Media(Media\_ID)
    - Membership\_Types(Membership\_Type)
    - Clients(Client\_ID)
    - Staff(Staff\_ID)
    - Borrowing\_Transactions(Transaction\_ID)
    - Reservations(Reservation\_ID)
    - Notifications(Notification\_ID)
  - Foreign Keys:

- Clients.Membership\_Type → Membership\_Types(Membership\_Type)
- Borrowing\_Transactions.Client\_ID → Clients(Client\_ID)
- Borrowing\_Transactions.Book\_ID → Books(Book\_ID) (nullable)
- Borrowing\_Transactions.Media\_ID → Digital\_Media(Media\_ID) (nullable)
- Reservations.Client\_ID → Clients(Client\_ID)
- Reservations.Book\_ID → Books(Book\_ID) (nullable)
- Reservations.Media\_ID → Digital\_Media(Media\_ID) (nullable)
- Notifications.Client\_ID → Clients(Client\_ID)
- Functional Dependencies (FDs):
  - Books:
    - Book\_ID → Title, Author, ISBN, Publication\_Year, Genre, Availability\_Status
  - Digital\_Media:
    - Media\_ID → Title, Creator, Format, Publication\_Year, Genre, Availability\_Status
  - Clients:
    - Client\_ID → Name, Contact\_Info, Membership\_Type, Account\_Status
    - Membership\_Type → Borrowing\_Limit, Reserving\_Limit, Late\_Fee\_Rate
  - Membership\_Types:
    - Membership\_Type → Borrowing\_Limit, Reserving\_Limit, Late\_Fee\_Rate
  - Staff:
    - Staff\_ID → DOB, Work\_Phone\_Number, Work\_Email
  - Borrowing\_Transactions:
    - Transaction\_ID → Client\_ID, Book\_ID, Media\_ID, Borrow\_Date, Due\_Date, Return\_Date, Fine\_Amount
  - Reservations:
    - Reservation\_ID → Client\_ID, Book\_ID, Media\_ID, Reservation\_Date, Status
  - Notifications:
    - Notification\_ID → Client\_ID, Message, Sent\_Date

Relational schema diagram:



## Data Dictionary:

Table	Column	Domain/Type	Constraints
Library_Material	Material_ID	INT(0 < n < 1,000,000,000)	PK
	Title	VARCHAR	
	Publication_Year	INT	
	Genre	VARCHAR	
	Availability_Status	ENUM('Available', 'Checked Out', 'Reserved')	
	Type	ENUM('Book', 'Digital Media', 'Magazine')	indicates subtype
Books	Book_ID	INT(0 < n < 1,000,000,000)	PK
	Material_ID	INT	FK → Library_Material(Material_ID)
	Author	VARCHAR	
	ISBN	INT(0 < n < 10,000,000,000,000)	UNIQUE
Digital_Media	Media_ID	INT(0 < n < 1,000,000,000)	PK
	Material_ID	INT	FK → Library_Material(Material_ID)
	Creator	VARCHAR	
	Format	NUM('eBook', 'Audiobook', 'DVD', ...)	
Magazine	Magazine_ID	INT(0 < n < 1,000,000,000)	PK
	Material_ID	INT	FK → Library_Material(Material_ID)
	Issue_Number	INT	
	Publish_Date	DATE	
Membership_Types	Membership_Type	ENUM('Regular', 'Student', 'Senior Citizen')	PK
	Borrowing_Limit	INT	
	Reserving_Limit	INT	
	Late_Fee_Rate	DECIMAL	
Clients	Client_ID	INT (0 < n < 1,000,000,000)	PK
	Name	VARCHAR	
	Contact_Info	VARCHAR	
	Membership_Type	ENUM('Regular', 'Student', 'Senior Citizen')	FK → Membership_

Staff	Membership_Types	ENUM('Active','Suspended')	Types (Membership_Type)
	Account_Status		
	Staff_ID	INT (0 < n < 1,000,000,000)	PK
	DOB	DATE	
Borrowing_Transactions	Work_Phone_Number	VARCHAR	
	Work_Email	VARCHAR	
	Transaction_ID	INT (0 < n < 1,000,000,000)	PK
	Client_ID	INT	FK → Clients (Client_ID)
Reservations	Material_ID	INT	FK → Library_Material (Material_ID)
	Borrow_Date	DATE	
	Due_Date	DATE	
	Return_Date	DATE	
	Fine_Amount	DECIMAL (0 < n < inf)	
	Reservation_ID	INT (0 < n < 1,000,000,000)	PK
	Client_ID	INT	FK → Clients (Client_ID)
	Material_ID	INT	FK → Library_Material (Material_ID)
Notifications	Reservation_Date	DATE	
	Status	ENUM('Active','Fulfilled','Cancelled')	
	Notification_ID	INT (0 < n < 1,000,000,000)	PK
	Client_ID	INT	FK → Clients (Client_ID)
	Message	TEXT	
	Sent_Date	DATE	