Library Management System - Project Part D: Logical Relational Model

EECS447: Database Systems
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Revisions

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Version	Date	Author	Description
1.8	10/08/25	Nick, Ashton, Cole, Sean, Yadhunath	Made the initial draft, assigned roles, created the document template.
1.9	10/15/25	Nick, Ashton, Cole, Sean, Yadhunath	Worked on finalizing the Logical Relation model and performed final clean-up for submission.
1.10	10/17/25	Nick, Ashton, Cole, Sean, Yadhunath	Finished draft and discussed future edits.

Project Overview:

This Library Management System (LMS) project aims to efficiently manage extensive book information, memberships, clientele, profiles, and accounts. Its database consolidates a vast amount of data, presenting it through an intuitive and easily navigable interface for user convenience.

Scope:

- This project focuses on developing a comprehensive resource management system for books and magazines. It will store key details such as title, author, ISBN/issue number, publication date, genre, and availability.

- Additionally, the system will feature a client and membership management component. This will include unique IDs, contact information, various membership categories (regular, student, senior, none), and defined borrowing restrictions.

- A tracking system will be implemented to manage borrowed, returned, and reserved media. This system will record timestamps, client details, and enforce rules regarding borrowing limits and late return fees.

- Finally, a user interface will be developed to enable staff to efficiently manage operations. This includes checking out and returning items, adding new resources, managing client accounts, calculating fines, and viewing both resource availability and client profiles.

Glossary

- ***Primary Key***: A candidate key that is chosen by the database designer to uniquely identify each tuple in a relation. It is a minimal key, meaning it uniquely identifies a tuple but no proper subset of its attributes can uniquely identify a tuple.
- ***Foreign Key:*** A foreign key is a field (or collection of fields) in one table that uniquely identifies a row of another table.
- ***Relationship:*** An association between two or more entities or tables in a database that represents how these entities are connected.

Relational Schema Mapping

Identify Relations

- ***Clients:*** stores the *name, phone number, email, member type* and *account status f*or each of the clients who are identified by a unique client id number (*clid*).

- ***Membership Types:*** stores the basic information such as *Checkout Length, late fee,* and *borrowing limit,* that can vary based on attributes *"Membership type"- Educators, General, Seniors, or none* - and *membership_type_id.*

- ***Items****:* The main relation that would store important relations about *title, publisher, publication date, availability* of each item *type (Book, Media, Magazine),* that are identified by the *item_id.*

- ***Books****:* An entity that stores the information about books (item type) such as *genre, author_firstname, author_lastname* and *ISBN* that are identified by *item_id.*

- ***Media****:* An entity that stores the *director_first* and *director_last* of the media (item type) that are identified by *item_id.*

- ***Magazines****:* An entity that stores the *issue/number* of magazines (item type) that is identified by *item_id.*

- ***Reservation****:* A relationship between Items and clients relations, which will be useful to keep track of the reservations by check through the attributes like *reserved_by and data_of_reservation* where the clients will *clid* and their corresponding items would be identified by *item_id.*

- ***Borrowed_by****:* a relation for bridging Clients and Items table that will store information on *checkout_dates* and *reserved by* attributes, where each client is identified by their respective *clid.*

- ***Has a:*** A bridging relation between the Clients and the membership to find the type of membership (*membership_type*) that each client (*clid*) *has.*

Define Attributes and Domains

Relation name	***Attribute***	***Domain***	***Description***
Clients	***account status***	VARCHAR(10)	***active/inactive***
	member type	VARCHAR(20)	***FK***
	email	VARCHAR(50)	
	phone	INT	
	clid	INT	***PK***
	name	VARCHAR(20)	
Membership types	***Checkout length***	INT	
	Late fee	DECIMAL(5,2)	***dollars/day***
	member type	ENUM(‘Education’,’Senior’,’General’, ’none’)	
	Borrowing limit	INT	
	member_type_id	INT	***PK***
Items	***publisher***	VARCHAR(50)	
	availability	BOOLEAN	
	publication_date	DATE	
	item_id	INT	***PK***
	type	ENUM(‘Book’, ‘Media’, Magazine’)	
	title	VARCHAR(100)	
Books	***genre***	VARCHAR(20)	
	item_id	INT	***FK***

	Author_firstname	VARCHAR(50)	
	Author_lastname	VARCHAR(50)	
	ISBN	INT	
Media	***Item_id***	INT	***FK***
	Director_first	VARCHAR(50)	
	Director_last	VARCHAR(50)	
Magazine	***Item_id***	INT	***FK***
	Issue/number	INT	
Reservation	***reserved_by***	VARCHAR(20)	
	date_of_reservation	DATE	
	clid	INT	***FK***
	item_id	INT	***FK***
borrowed_by	***checkout_date***	DATE	
	borrowed_by	VARCHAR(20)	
	item_id	INT	***FK***
	clid	INT	***FK***
Has a	***clid***	INT	
Virtual Relation *View, not table, so there is no key behavior*	***member_type_id***	INT	

HAS_A View:

```
SELECT
        c.clid,
        c.member_type as client_membership,
        m.member_type_id as member_id
FROM clients c
```

JOIN memberships m
ON client_membership = member_id

Define Primary Keys

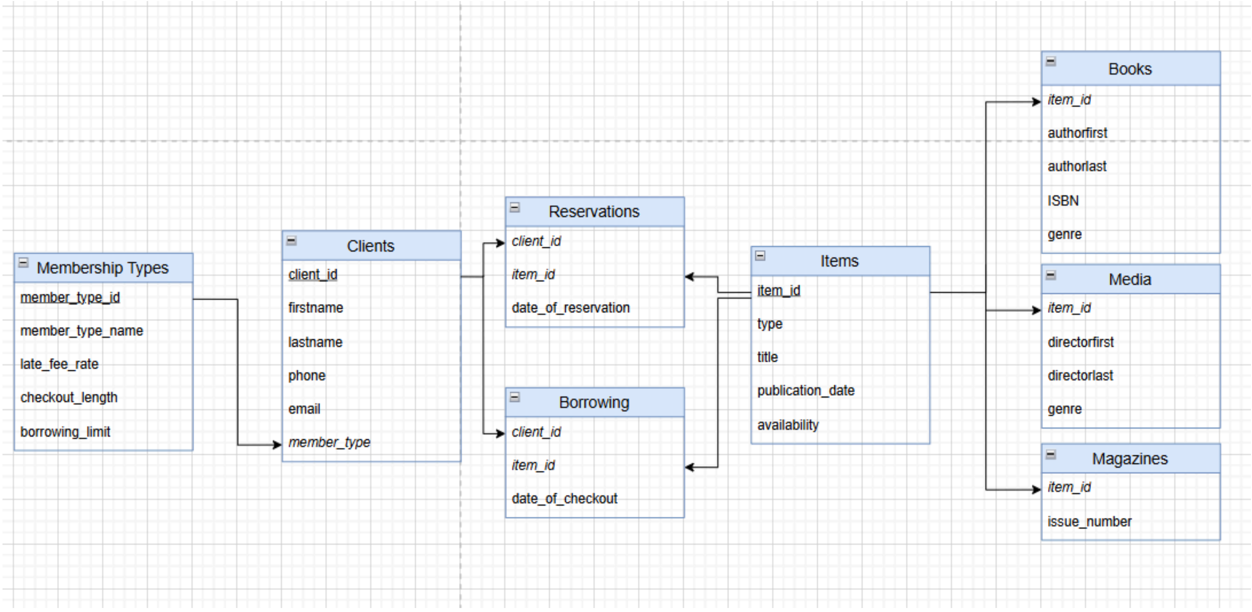
Relation (Table)	***Primary Key***
Clients	*clid*
Membership Types	*member_type_id*
Items	*item_id*
Books	*item_id*
Media	*item_id*
Magazines	*item_id*
Reservation	*clid, item_id*
Borrowed_by	*item_id*
Has a	*clid*

****Talk with Professor about potential FK?***
Establish Foreign Keys

Relation (Table)	***Foreign Key***	***Refers to***
Clients	***member_type***	***Membership Types(member_type_id)***
Membership Types		
Items		
Books	***item_id***	***Items(item_id)***
Media	***item_id***	***Items(item_id)***
Magazines	***item_id***	***Items(item_id)***
Reservation	***clid***	***Clients(clid)***

Borrowed_by	***clid***	***Clients(clid)***
	item_id	***Items(item_id)***
Has a	***clid***	***Clients(clid)***
	member_type_id	***Membership Types(member_type_id)***

Relational Schema Diagram



Schema Documentation with a Data Dictionary

Attribute	***Data Types***	***Description***
item_id	INT	A unique Identification number for each item in the library.
type	VARCHAR	Defines whether the item is a book, magazine, or media
title	VARCHAR	The title for the item
publication_date	DATE	Publication date of the item
publisher	VARCHAR	Publisher of the item

availability	VARCHAR	If the item is ready for check out
member_type_id	INT	Type of membership
clid	INT	Client ID
member_type	ENUM(‘Education’,’Senior’,’General’)	Type of membership
firstname	VARCHAR	First name of client
lastname	VARCHAR	Last name of client
Phone	BIGINT	Phone number of client
email	VARCHAR	Email of client
data_of_reservation	DATE	Date an item was reserved
late_fee_rate	DECIMAL(5,2)	Late fee charge
checkout_length	INT	Length of check out
borrowing_limit	INT	How many items a client can check out at once
ISBN	CHAR(13)	Unique number given to identify books
genre	VARCHAR	Genre type of book
issue_number	INT	Issue number of magazine
authorfirst	VARCHAR	First name of author
authorlast	VARCHAR	Last name of author
directorfirst	VARCHAR	First name of director
directorlast	VARCHAR	Last name of director