

## Charles Library Management System

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## Section I: Project Description

Charles library management system is a database management system that is built to handle the general library data which could include information of subscriber, employee, books incoming and outgoing. It can do task such as keep track of the books and their checkouts after the subscriber or library staff request for book that could be for short period or long period. Library database system is also responsible for maintaining database for incoming new books and keep track of the books that have been borrowed with the respective due dates.

The main problem subscriber or library staff faces is the retrieval of book or article that they require from the vast library database. So, the library database system will be able to retrieve desired books or articles accurately. It will make sure to identify if the books are in stock, it's availability date, out of stock or not available.

## Section II: Use Cases

1.

Use Case Title	Library Content
Actors	Library, Subscriber
Description	Library has books, catalogue, magazines, newspapers, DVDs, eBooks, video, audio, internet articles. Only the library subscriber can preview these contents.

2.

Use Case Title	Registration
Actors	User, Subscriber
Description	User must register with their name, mailing address, phone number, SSN. Subscriber must have their payment information.

3.

Use Case Title	Book search
Actor	Subscriber, Librarian
Description	Each book will have ISBN number, author name, title, edition, and publisher. Subscriber log into the Charles Library system with user id or staff id. If the login is successful, book can be search by their title, ISBN number, author name, Genre. If book is found, it should be displayed in the screen with its availability with no. in stocks, length of rent, rack location and its edition. If it's not available, it should display its approximation available date.

4.

Use Case Title	Book Reserve
Actors	Subscriber, System, library staff
Description	Alex wants to rent a Beauty and Beast book from Charles library. Alex needs a subscription as a prerequisite first in the system. Alex has subscription, he can log in into the system with his user id and password. Alex book is not available now, so he wants to reserve it. To reserve there should be no pending fines, account should be clear from any pending due dates

5.

Use Case Title	Reviews
Actors	Book, subscriber, librarian
Description	Books can have reviews. The review can be made by subscriber. Subscriber can give rating to a book as well as comment on a book.

6.

Use Case Title	Extend due date
Actor	subscriber
Description	All the book rented from the library has a due date. If subscriber fails to return the book by due date, library will charge fine. Alex's Beauty and Beast book is due soon. But Alex wants to keep book for extra days. So, he logs into his account with his subscriber ID and password where he can see his pending due dates. He selects the order he wants to extend, if no one else has reserved it already. To extend due date there should be no pending fines, account should be clear from any pending due dates.

7.

Use Case Title	Roles
Actor	Librarian
Description	Librarian has permission to manage contents in library. Librarian can access subscriber account and make changes to the account. Librarian has permission to delete inappropriate reviews. Librarian can only extend book due date.

8.

Use case title	Payroll
Actors	Employee
Description	Charles library have many employees. Library needs to pay them salary. Each department has their pay grade.

## Section III: Database Requirement

### 1. User

- 1.1 . User shall create zero or one account
- 1.2 . User shall have at least one role
- 1.3 . User shall have many payments method
- 1.4 . User shall make many reviews
- 1.5 . User shall have one unique user id
- 1.6 . User shall have one name
- 1.7 . User shall have one unique ssn
- 1.8 . User shall have at least one mailing address
- 1.9 . User shall have one phone number

### 2. Subscriber

- 2.1. Subscriber is a user
- 2.2. Subscriber have register to one and only library
- 2.3. Subscriber shall have at least one role
- 2.4. Subscriber shall rent at least one book
- 2.5. Subscriber shall have one unique subscriber id

### 3. Librarian

- 3.1. Librarian is a user
- 3.2. Librarian shall have one and only one account
- 3.3. Librarian shall have at least one role
- 3.4. Librarian shall rent at least one book
- 3.5. Librarian shall have one unique librarian id

### 4. Book

- 4.1. Book shall have many reservations
- 4.2. Book shall be included in many catalogues
- 4.3. Books shall have many reviews
- 4.4. Books shall have many publishers
- 4.5. Books shall have many authors
- 4.6. Books shall be placed in many racks
- 4.7. Books shall be rented by many subscriber
- 4.8. Books shall be rented by many librarians
- 4.9. Books shall have one unique ISBN
- 4.10. Books shall have one and only one title
- 4.11. Books shall have many genre
- 4.12. Books shall have many publishers name
- 4.13. Books shall have many authors name
- 4.14. Books shall have only one edition

4.15. Books shall have one stock number

5. Roles

- 5.1. A Role shall be linked to many subscriber
- 5.2. A Role shall be linked to many librarians
- 5.3. A Role shall have many accounts permission
- 5.4. A Role shall have many admin permission
- 5.5. A Role shall have only one role id
- 5.6. A Role shall have only one name
- 5.7. A Role shall have a description

6. Set of Permission

- 6.1. Set of permission is account permission
- 6.2. Set of permission is admin permission
- 6.3. Set of permission shall have only one account
- 6.4. Set of permission shall have only one permission id
- 6.5. Set of permission shall have only one permission name

7. Account

- 7.1. An account shall have one and only one user
- 7.2. An account shall belong to one and only one library
- 7.3. An account shall have one and only one expiration date
- 7.4. An account shall have one unique account id
- 7.5. An account shall have one account creation date
- 7.6. An account shall have one penalty amount

8. Employee

- 8.1. Employee shall work in only one library
- 8.2. Employee shall work in one and only one department
- 8.2. Employee shall receive one and only one payroll
- 8.3. Employee shall have one employee id
- 8.4. Employee shall have one unique ssn
- 8.5. Employee shall have one mailing address
- 8.6. Employee shall have one name
- 8.7. Employee shall have one bank information
- 8.8. Employee shall have one contact information

9. Permission

- 9.1. Permission shall be assigned to at least one role.
- 9.2. Permission shall have one unique permission id

## 10. Departments

- 10.2. Department shall have many employee
- 10.3. Department shall have at least one paying grade
- 10.4. Department shall have one department id
- 10.5. Department shall have department name

## 11. Library

- 11.1. Library shall have many employees
- 11.2. Library shall have many librarian
- 11.3. Library shall have many publishers
- 11.4. Library shall have many subscriber
- 11.5. Library shall have many audio
- 11.6. Library shall have many video
- 11.7. Library shall have many racks
- 11.8. Library shall have many eBooks
- 11.9. Library shall have one name
- 11.10. Library shall have one location
- 11.11. Library shall have many contact information
- 11.12. Library shall have many email address

## 12. Reservation

- 12.1. Reservation shall have at least one books
- 12.2. Reservation shall be made by many subscriber
- 12.3. Reservation shall be made by many librarian
- 12.4. Reservation shall have one unique reservation id
- 12.5. Reservation shall have one reservation start date
- 12.6. Reservation shall have one reservation expire date

## 13. Payroll

- 13.1. Payroll shall be given to one employee
- 13.2. Payroll shall determine many paygrade
- 13.3. Payroll shall have many employee's salary
- 13.4. Payroll shall have one unique transaction id
- 13.5. Payroll shall have one reimbursement date

## 14. Paygrade

- 14.1. Paygrade shall determine one and only one payroll
- 14.2 Paygrade shall depend on one department employee works
- 14.3 Paygrade shall have one unique grade id
- 14.4. Paygrade shall have many paygrade name

## 15. Payment Method

- 15.1. Payment method shall be used by at least one user



- 15.2. Payment method shall have at least one billing address
- 15.3. Payment method shall have one and only one expiration date
- 15.4. Payment method shall have payment id

## 16. Catalogue

- 16.1. Catalogue shall include at least one books
- 16.2. Catalogue shall be placed in many racks
- 16.3. Catalogue shall have one unique catalogue id
- 16.4. Catalogue shall have one issue date
- 16.5. Catalogue shall have one category

## 17. DVD

- 17.1. DVDs shall have at least one title
- 17.2. DVDs shall be placed in many racks
- 17.3. DVDs shall have one unique dvd id
- 17.4. DVDs shall have one production

## 18. Newspaper

- 18.1. Newspaper shall be placed in many racks
- 18.2. Newspaper shall have one unique id
- 18.3. Newspaper shall have one title
- 18.4. Newspaper shall one publisher

## 19. Publisher

- 19.1. Publisher shall supply to many libraries
- 19.2. Publisher shall have many books
- 19.3. Publisher shall have one publisher id
- 19.4. Publisher shall have one publisher name
- 19.5. Publisher shall have many contacts information

## 20. eBook

- 20.1. eBook shall have at least one publisher
- 20.2. eBook shall be included in one library
- 20.3. eBook shall have many authors
- 20.4. eBook shall have one unique eBook id
- 20.5. eBook shall have one title
- 20.6. eBook shall have one genre
- 20.7. eBook shall have one publisher
- 20.8. eBook shall have one author

## 21. Reviews

- 21.1. Reviews shall be made by many subscriber
- 21.2. Reviews shall be made by many librarian

- 21.3. Reviews shall be included in many books
- 21.4. Reviews shall be edited by many librarian
- 21.5. Reviews shall have one unique review id
- 21.6. Reviews shall have one timestamp
- 21.7. Reviews shall have many comments

## 22. Author

- 22.1. Author shall have many books
- 22.2. Author shall have one unique author id
- 22.3. Author shall have one name
- 22.4. Author shall have many contact information

## 23. Racks

- 23.1. Racks shall have many book
- 23.2. Racks shall have many magazines
- 23.3. Racks shall have many DVDs
- 23.4. Racks shall be in only one library
- 23.5. Racks shall have one unique rack id
- 23.6. Racks shall have one rack identifier

## 24. Audio

- 24.1. Audio shall be included in one library
- 24.2. Audio shall have one unique audio id
- 24.3. Audio shall have many language
- 24.4. Audio shall have one title

## 25. Video

- 25.1. Video shall be included in one library
- 25.2. Video shall have one title
- 25.3. Video shall have one unique video id
- 25.4. Video shall have many language

## 26. Internet Article

- 26.1. Internet Article shall be included in in library
- 26.2. Internet Article shall have many authors
- 26.3. Internet Article shall have one unique article id
- 26.4. Internet Article shall have one title
- 26.5. Internet Article shall have one author
- 26.6. Internet Article shall have one publisher

## 27. Magazines

- 27.1. Magazine shall be supplied by many publishers
- 27.2. Magazines shall be placed in many racks

- 27.3. Magazines shall have one unique magazine id
- 27.4. Magazines shall have one title
- 27.5. Magazines shall have one publisher

## Section IV: Detailed list of Main Entries, Attributes, and Keys

1. User (Strong)
  - user\_id: key, numeric
  - user\_name: composite, alphanumeric
  - user\_ssn: single-value, numeric
  - user\_mailing address: alphanumeric
  - user\_contactinfo: numeric
2. Book (Strong)
  - ISBN: key, numeric
  - Book\_title: composite, alphanumeric
  - Book\_author: composite, alphanumeric
  - Book\_genre: composite, alphanumeric
  - Book\_publisher: composite, alphanumeric
  - Book\_edition: alphanumeric
  - Book\_stock: numeric
3. Library (Strong)
  - Library\_id: key, numeric
  - Library\_name: composite, alphanumeric
  - Library\_address: composite, alphanumeric
  - library\_contact\_info: numeric
  - Library\_email: alphanumeric
4. Role (Strong)
  - role\_id: key, numeric
  - role\_name: alphanumeric
  - role\_description: alphanumeric
5. Department(Weak)
  - Department\_id: key, numeric
  - Department\_name: alphanumeric
6. Publisher(Strong)
  - Publisher\_id: key, numeric
  - Publisher\_name: composite, alphanumeric
  - Publisher\_contactinfo: numeric
7. Newspaper (Strong)
  - Newspaper\_id: Key, numeric
  - Newspaper\_title: composite, alphanumeric
  - Newspaper\_publication: composite, alphanumeric

8. Magazines ( Strong)  
Magazine\_id: key, alphanumeric  
Magazine\_title: alphanumeric  
Magazine\_publication: alphanumeric
9. DVDs (Strong)  
Dvd\_id: key, alphanumeric  
Dvd\_title: alphanumeric  
Dvd\_production: composite, alphanumeric
10. eBook (Strong)  
eBook\_id: key, alphanumeric  
eBook\_title: alphanumeric  
eBook\_genre: alphanumeric  
eBook\_author: composite, alphanumeric  
eBook\_publisher: composite, alphanumeric
11. Internet Articles (Strong)  
Article\_id: key, numeric  
Article\_title: alphanumeric  
Article\_author: composite, alphanumeric  
Article\_publisher: composite, alphanumeric
12. Audio(Strong)  
Audio\_id: key , numeric  
Audio\_title: composite, alphanumeric  
Audio\_language: alphanumeric
13. Video(Strong)  
Video\_id: key, numeric  
Video\_title: alphanumeric  
Video\_language: alphanumeric
14. Payroll (strong)  
Transaction id: key, alphanumeric  
Emp\_salary: numeric  
Reimbursement\_date: numeric
15. Reviews (Strong)  
Review\_id: numeric  
Review\_timestamp: alphanumeric  
Review\_comments: alphanumeric
16. Payment Method(strong)

Payment\_id: key, numeric  
Payment\_billaddress: composite, alphanumeric  
Payment\_name: composite, alphanumeric  
Payment\_expirationdate: numeric

17. Racks (Strong)

Rack\_id: key, numeric  
Rack\_identifier: alphanumeric

18. Reservation(weak)

Reservation\_id: key, numeric  
Reservation\_start\_date: numeric  
Reservation\_expire\_date: numeric

19. Librarian(weak)

Lib\_id: key, numeric

20. Account(weak)

Acc\_expdate: numeric  
Acc\_startdate: numeric  
Acc\_id: key,numeric  
Acc\_penalty: numeric

21. Subscriber(weak)

Subscriber\_id: key, numeric

22. Catalogue (Weak)

Catalog\_id: key, numeric  
Catalog\_category: alphanumeric  
Catalog\_issuedate: numeric

23. Employee(weak)

Employee\_id: key, numeric  
Employee\_name: composite, alphanumeric  
Employee\_address: composite, alphanumeric  
Employee\_ssn: numeric  
Employee\_bankinfo: composite, alphanumeric  
Employee\_contactinfo: numeric

24. Pay grade (weak)

Grade\_id: key, numeric  
Grade\_name: alphanumeric

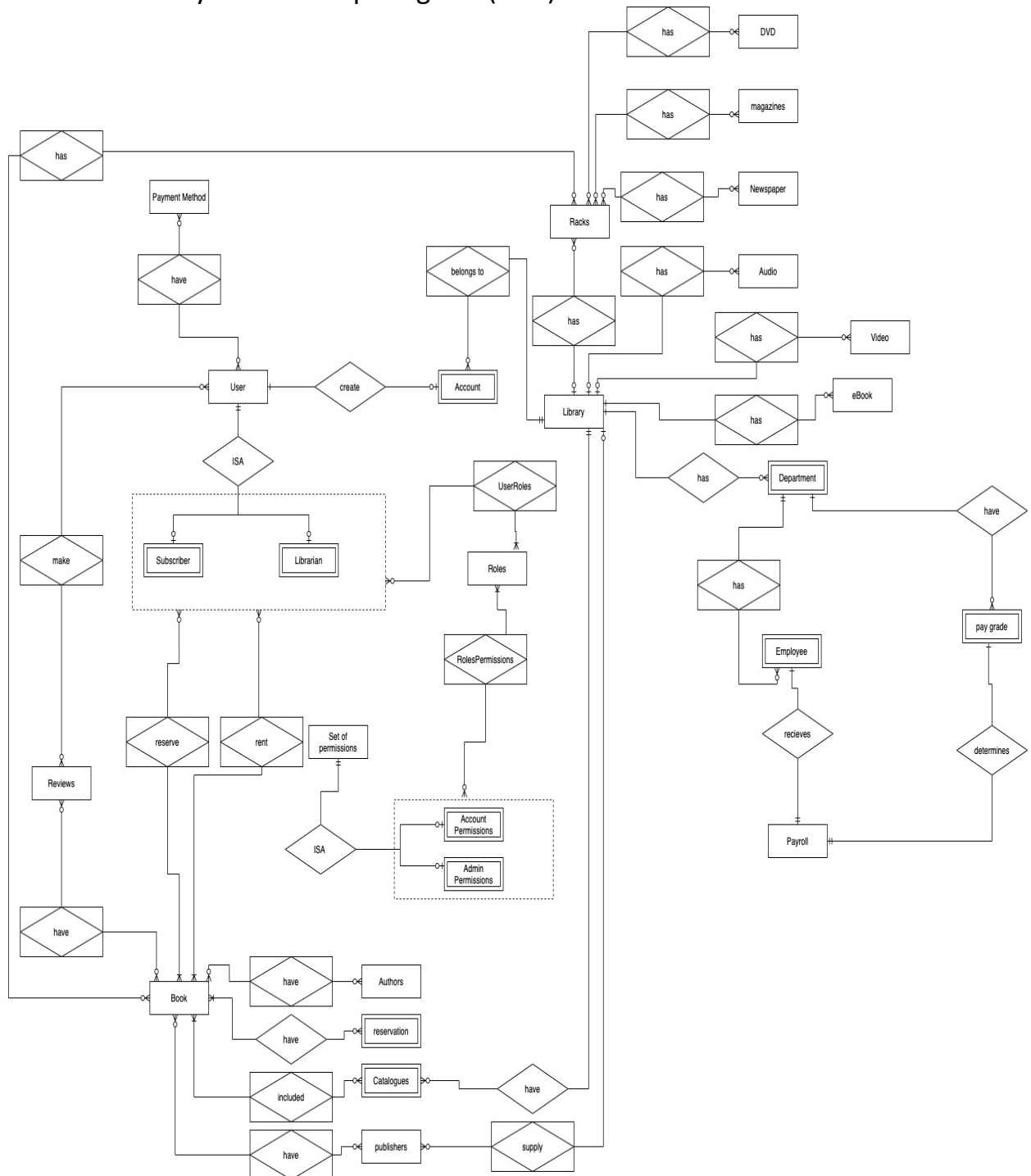
25. Author ( Strong)

Author\_id: key, numeric

Author\_name: composite, alphanumeric

Author\_contactinfo: alphanumeric

## Section V: Entity Relationship Diagram (ERD)





## Section VI: Testing Table

Rule	Entity A	Relation	Entity B	Cardinality	Pass/Fail	Error Description
1.	User	creates	Account	1 to 1	Pass	None
2.	User	have	role	1 to M	Fail	User is strong. User is a subscriber and librarian. (aggregation)
3.	User	have	Payment method	M to N	Pass	None
4.	Subscriber	Have	Account	1 to 1	pass	None
5.	Subscriber	make	reviews	M to N	Fail	Weak entity can't be strong.
6.	Librarian	have	account	1 to 1	Pass	None
7.	Librarian	Make	reviews	M to N	Fail	Weak entity can't be strong
8.	Role	linked	users	M to N	Fail	Users can't have role before they register.
9.	Roles	have	permission	M to N	Pass	None
10.	Library	have	department	M to N	Fail	Department is strong, and needs to be strong
11.	Library	Have registered	subscribers	M to N	Fail	It would be more appropriate to say account belongs to library
12.	Library	Have registered	librarians	M to N	Fail	It would be more appropriate to say account belongs to library
13.	Library	have	audio	M to N	Pass	None
14.	Library	Have	video	M to N	pass	None
15.	Library	Have	racks	M to N	pass	None
16.	Library	Have	eBooks	M to N	pass	None
17.	Books	Have	authors	M to N	pass	None
18.	Books	Have	publishers	M to N	pass	None
19.	Books	Have	reservation	M to N	Fail	Cardinality error. Reservation need at least one book

20.	Books	Have	reviews	M to N	pass	None
21.	Books	included	catalogue	M to N	Fail	Cardinality error
22.	Books	placed	racks	M to N	Pass	None
23.	Books	Rent	subscriber	M to N	Pass	None(aggregation)
24.	Books	Rent	Librarian	M to N	Pass	None(aggregation)
24.	Racks	have	DVDs	M to N	Pass	None
25.	Racks	have	magazines	M to N	Pass	None
26.	Reservation	by	subscriber	M to N	Pass	None(aggregation)
27.	Reservation	by	Librarians	M to N	Pass	None(aggregation)
28.	Department	has	employee	M to N	Fail	Relationship with library make Department weak, but it is strong, employee needs to be weak as well.
29.	Employee	receives	Payroll	1 to 1	Pass	None
30.	Payroll	determines	paygrade	1 to M	Pass	None
31.	Department	has	paygrade	1 to M	Pass	None

## Section VII: Database Model/EER

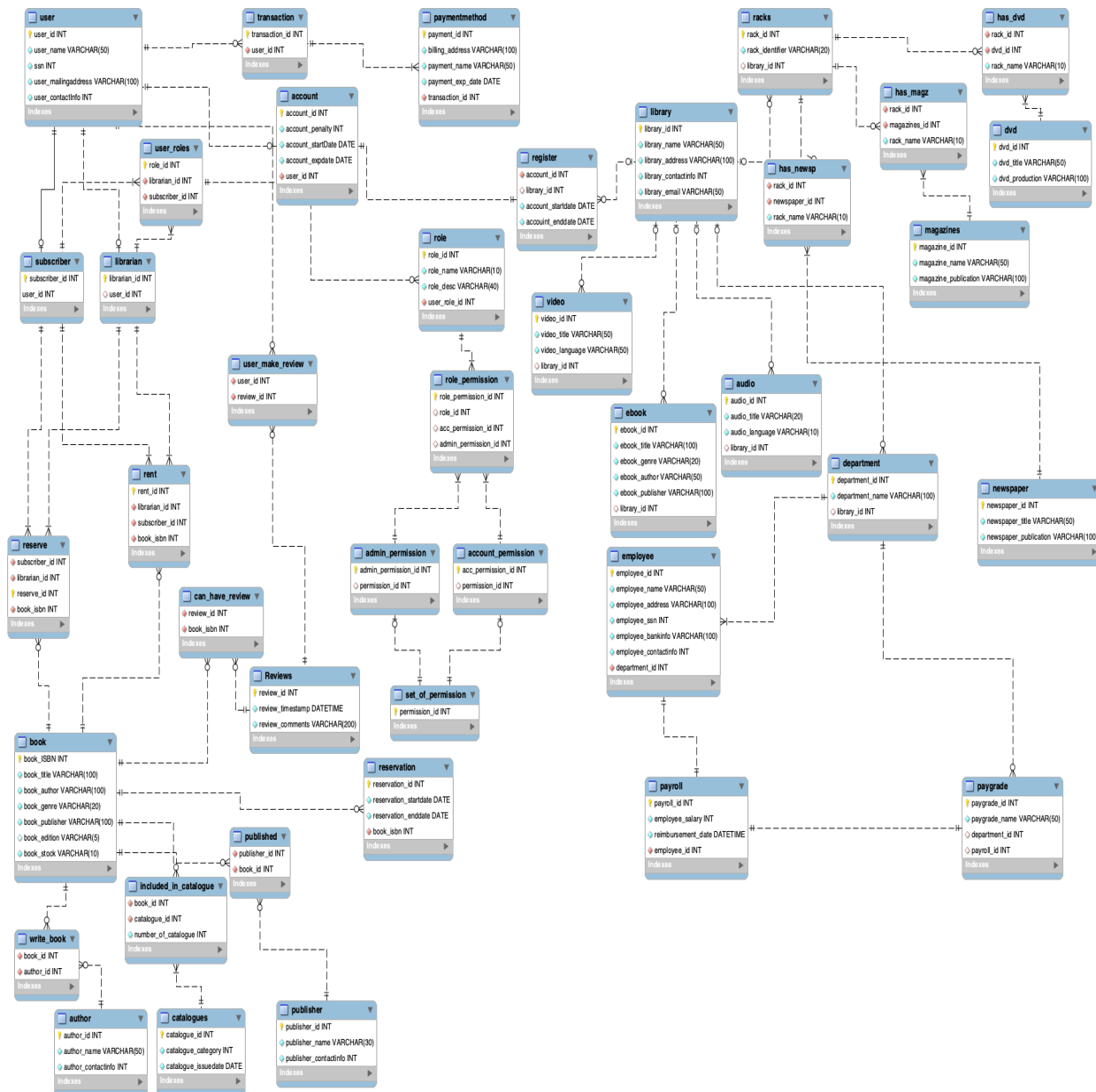


Table	FK	ON DELETE	On UPDATE	Comment
Account	User	Cascade	Cascade	If a user is deleted, then the account from that user must be deleted as well
Librarian	User	Cascade	Cascade	If a user is deleted, then Librarian must be deleted as well
Subscriber	User	Cascade	Cascade	If a user is deleted, then subscriber must be deleted as well
User_roles	Subscriber	Set Null	Cascade	If a role is deleted from the subscriber table, the subscriber that was holding that role will have no role until a new one is assigned.
User_roles	Librarian	Set Null	Cascade	If a role is deleted from the librarian table, the librarian that was holding that role will have no role until a new one is assigned.
Role	User_roles	Cascade	Cascade	If a user_role is deleted from the role table, the users(librarian and subscriber) that was holding that role will have no role until a new one is assigned.
Role_permission	role	Set Null	Cascade	If a role is deleted from the role_permission table, the users(librarian and subscriber) that was holding that role will have no role until a new one is assigned.
Role_permission	Account_permission	Set Null	Cascade	If a account_permission is deleted from the role table, the users(librarian and subscriber) that was holding that role will have no role until a new one is assigned.
Role_permission	Admin_permission	Set Null	Cascade	If a admin_permission is deleted from the role table, the users(librarian and subscriber)

				that was holding that role will have no role until a new one is assigned.
Account_permission	Set_permission	Set Null	Cascade	If a set_permission is deleted from the account_permission table, the users(librarian and subscriber) that was holding that role will have no role until a new one is assigned.
Admin_permission	Set_permission	Set Null	Cascade	If a set_permission is deleted from the admin_permission table, the users(librarian and subscriber) that was holding that role will have no role until a new one is assigned.
Payment Method	user	Cascade	Cascade	If a user is deleted, then payment method must be deleted as well
Author	Book	Cascade	Cascade	If a book is deleted, then author must be deleted as well
Catalogues	Book	Cascade	Cascade	If a book is deleted, then catalogues must be deleted as well
Publisher	Book	No Action	Cascade	If publisher is deleted, then no action is needed
Reserve	Book	Cascade	Cascade	If book is deleted, then reserve must be deleted as well
Reserve	Subscriber	Cascade	Cascade	If subscriber is deleted, then reserve must be deleted as well
Reserve	Librarian	Cascade	Cascade	If librarian is deleted, then reserve must be deleted as well
Rent	Book	Cascade	Cascade	If book is deleted, then rent must be deleted as well
Rent	Subscriber	Cascade	Cascade	If subscriber is deleted, then rent must be deleted as well
Rent	Librarian	Cascade	Cascade	If librarian is deleted, then rent must be deleted as well
library	account	No Action	Cascade	If account is deleted, then no action shall be taken
Rack	library	Cascade	Cascade	If library is deleted, then rack must be deleted as well
eBook	library	Cascade	Cascade	If library is deleted, then eBook must be deleted as well

newspaper	rack	Cascade	Cascade	If rack is deleted, then newspaper must be deleted as well
DVD	rack	Cascade	Cascade	If rack is deleted, then DVD must be deleted as well
Audio	library	Cascade	Cascade	If library is deleted, then Audio must be deleted as well
Video	library	Cascade	Cascade	If library is deleted, then Video must be deleted as well
Department	library	Cascade	Cascade	If library is deleted, then Department must be deleted as well
Employee	Department	Cascade	Cascade	If library is deleted, then employee must be deleted as well
Paygrade	Department	Cascade	Cascade	If library is deleted, then paygrade must be deleted as well
Paygrade	Payroll	Set Null	Cascade	If a payroll is deleted from the paygrade table, the department that was holding that payroll will have no paygrade until a new one is assigned.
Payroll	Employee	Cascade	Cascade	If employee is deleted, then payroll must be deleted as well

## Section XI: Testing Table

Entity	SQLQuery	Pass/Fail	Error Description	Possible Solution
User	Delete	Pass	None	None
User	Update	Pass	None	None
Book	Delete	Fail	Cannot delete or update a parent row: a foreign key constraint fails	Primary Key set Not Null. So, disabling it will probably solve it.
Book	Update	Pass	None	None
Publisher	Update	Pass	None	None
Publisher	Update	Pass	None	None
Set of permission	Delete	Pass	None	None
Set of permission	Update	Fail	Foreign key constraint for table 'set_of_permission', record '4' would lead to a duplicate entry in table 'account_permission', key 'permission_id_UNIQUE'	Permission id
Author	Delete	Pass	None	None
Payment Method	Delete	Pass	None	None
Payment Method	Update	Pass	None	None
Racks	Delete	Pass	None	None
Racks	Update	Pass	None	None
DVD	Delete	Pass	None	None
DVD	Update	Pass	None	None
Role	Delete	Pass	None	None
Role	Update	Pass	None	None
Reviews	Delete	Pass	None	None
Reviews	Update	Pass	None	None
Catalogues	Delete	Pass	None	None
Catalogues	Update	Pass	None	None
Library	Delete	Fail	Cannot delete or update a parent row: a foreign key constraint fails	Primary Key set Not Null. So, disabling it will probably solve it.
Library	Update	Pass	None	None
Magazine	Delete	Pass	None	None
Magazine	Update	Pass	None	None
Newspaper	Delete	Pass	None	None
Newspaper	Update	Pass	None	None
Audio	Delete	Pass	None	None
Audio	Update	Pass	None	None

Video	Delete	Pass	None	None
Video	Update	Pass	None	None
eBook	Delete	Pass	None	None
eBook	Update	Pass	None	None
payroll	Delete	Pass	None	None
Payroll	Update	Pass	None	None