

## **College Library Database:**

A College library database is used to maintain the books in the college library. It is usually maintained by a Library staff in the library, but after Database took a step into Management, a library Database can now be maintained even by the college administration at their desk.

### **Different Type of Actors/groups of people involved and also make use of the college library Database:**

- 1.Students/Professors
- 2.Library staff/Librarian
- 3.Author/Publisher

### **Requirements:**

A Student/Professor wants to borrow a particular book(s) of his choice by searching the Database based on the book id/book title/isbn. The student/professor might also want to check the Database to check the due date for the borrowed book.

A Library staff/Librarian maintains a complete list of books along with the author name, publisher name in the Database which are owned and available in the college library and also keeps track of the books lent and returned to the library by the student/professor(borrower) and also calculates the late\_fee amount if the book was returned after the due date.

An Author/Publisher can use the college library database by obtaining permission from the librarian to analyze the most borrowed or lent books that they have authored or published by using certain relations in the library database and in turn use the above information to find out which of their books is popular among the students/professor and also use the above information for various analysis purpose.

### **Different Relations to Meet the Requirements:**

#### **1.Author:**

Author				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Author_id	varchar	20	Primary key, not null	
Author_name	varchar	30	not null	
Address	varchar	50		
Phone_no	varchar	20	Not null	
E-mail	varchar	30		

**Primary key:** Author\_id

**Foreign key:** None

**Indices:**

Author relation saves the basic information about the author who has authored a particular book.

## 2.Publisher:

Publisher				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Publisher_id	Varchar	20	Primary key, not null	
Publisher_name	varchar	30	not null	
Address	varchar	50		
Phone_no	varchar	20	not null	
E-mail	varchar	30		

**Primary key:** Publisher\_id

**Foreign key:** None

**Indices:**

Publisher relation saves basic information about the publisher of a particular book.

## 3.Books:

Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Book_id	varchar	20	Primary key, not	
Title	varchar	40	not null	
Isbn	varchar	15	Unique key, not	
Publisher_id	varchar	15	Foreign key, not	
Published_year	date			
Edition	varchar	15		
Price	numeric	(6,2)		
Count	Int	3		

**Primary key:** Book\_id

**Foreign key:** Publisher\_id references Publisher(Publisher\_id)

**Indices:** Publisher\_id

Books relation saves information about the book and the publisher. Also the count and the year the book was published.

#### 4.Author\_Books:

Author Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Book_id	varchar	20	Composite key, Foreign key, not null	Delete on cascade
Author_id	varchar	20	Composite key, Foreign key, not null	Delete on cascade

**Composite key:** Book\_id + Author\_id

**Foreign key:** Book\_id references Books(Book\_id), Author\_id references Author(Author\_id)

**Indices:** Book\_id , Author\_id

Author\_books relation saves information about the multiple authors that might exist for a single book.

#### 5.Category:

Category				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Category_id	varchar	20	Primary key, not null	
Category_name	varchar	30	not null	
Category_description	varchar	40		

**Primary key:** Category\_id

**Foreign key:** None

**Indices:**

Category relation saves information about category name such as science, literature, business and also the description of the book category.

**6.Borrower:**

Borrower				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Borrower_id	varchar	20	Primary key, not null	
Name	varchar	30		
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
DOB	date			
Address	varchar	50		
Phone no	varchar	20	not null	
E-mail	varchar	30		

**Primary key:** Borrower\_id**Foreign key:** None**Indices:**

Borrower relation saves basic information of the borrower when the librarian needs to contact the borrower.

**7.Library\_staff:**

Library_staff				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Librarian_id	varchar	20	Primary key, not null	
Name	varchar	30	not null	
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
Admin	char	1	Check(Admin='y' or Admin='n')	

**Primary key:** Librarian\_id**Foreign key:** None**Indices:**

Library\_staff relation saves the basic information about the library staff who issue or collect books along their status as an admin or not.

**8.Book\_Lending:**

Book_Lending				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
Lending_id	varchar	20	Composite key, not null	
Fee_id	varchar	20	Composite key, not null	
Borrower_id	varchar	20	Foreign key, not null	Delete on cascade
Book_id	varchar	20	Foreign key, not null	Delete on cascade
Issue_date	timestamp			
Due_date	timestamp			
Return_date	timestamp			
Issued_by	varchar	20	Foreign key, not null	Delete on cascade
Collected_by	varchar	20	Foreign key, not null	Delete on cascade
Amount	numeric	(6,2)		

**Composite key:** Lending\_id + fee id

**Foreign key:** Borrower\_id references Borrower(Borrower\_id), Book\_id references Books(Book\_id), Issued\_by references library\_staff(Librarian\_id), Collected\_by references library\_staff(Librarian\_id)

**Indices:** Borrower\_id , Book\_id , Issued\_by(Librarian\_id) , Collected\_by(Librarian\_id)

Book\_Lending relation saves the information about the borrowed book . the borrower and the library staff who issues and collects the book and also for calculating the fines if a book is returned after due date.

**Unnormalized Relation:**

Below is the unnormalized relation that would meet all the requirements.

Attribute Name	Data Type	Size
Author_id	varchar	20
Author_name		
-Author_fname	varchar	20
-Author_mname	varchar	6
-Author_lname	varchar	20

Address	varchar	50
{Auth_Phone_no}	varchar	20
{Auth_E-mail}	varchar	30
Publisher_id	varchar	20
Publisher_name		
-Publisher_fname	varchar	20
-Publisher_mname	varchar	6
-Publisher_lname	varchar	20
Address	varchar	50
{Pub_Phone_no}	varchar	20
{Pub_E-mail}	varchar	30
Book_id	varchar	20
Title	varchar	40
Isbn	varchar	15
Published_year	date	
Edition	varchar	15
Price	numeric	(6,2)
Count	Int	3
Category_id	varchar	20
Category_name	varchar	30
Category_description	varchar	40
Borrower_id	varchar	20
Borrower_Name		

-Borrower_fname	varchar	20
-Borrower_mname	varchar	6
-Borrower_lname	varchar	20
Gender	char	1
DOB	date	
Address	varchar	50
{Borr_Phone_no}	varchar	20
{Borr_E-mail}	varchar	30
Librarian_id	varchar	20
Librarian_Name		
-Librarian_fname	varchar	20
-Librarian_mname	varchar	6
-Librarian_lname	varchar	20
Gender	char	1
Admin	char	1
Lending_id	varchar	20
Fee_id	varchar	20
Issue_date	timestamp	
Due_date	timestamp	
Return_date	timestamp	
Issued_by	varchar	20
Collected_by	varchar	20

Amount	numeric	(6,2)
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This relation has some multivalued attributes and they are mentioned in braces. The composite attributes and their subparts are also mentioned.

### Normalizing the Relations

#### 1NF:

A relation is in first normal form if and only if the domain of each attribute contains only atomic (indivisible) values, and the value of each attribute contains only a single value from that domain. And we need to identify the primary key for the relation.

#### **-Author:**

Author				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Primary key, not null	
Author_Name				
- Fname	varchar	20		
- Mname	varchar	6		
- Lname	varchar	20		
Address	varchar	50		
Phone_no	varchar	20	Not null	
E-mail	varchar	30		

For Author relation, Author\_id can be a primary key and phone\_no can have none or more values. Hence keeping the separate table for Author\_phone no and e-mail can also have none or more values, hence keeping a separate table for Author\_e-mail.

#### **-Author\_phone\_no:**

Author_phone no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Composite key, not null	Author
<b>Phone no</b>	varchar	20	Composite key, not null	

Author\_phone\_no is in 1NF and phone\_no can be a primary key for this relation.

Author\_phone\_no is in 1NF and Author\_id and Phone\_no can be a composite key for this relation.

#### **-Author\_e-mail:**

Author_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems



<b>Author_id</b>	varchar	20	Composite key, not null	Author
<b>E-mail</b>	varchar	20	Composite key, not null	

Author\_e-mail is in 1NF and Author\_id and E-mail can be a composite key for this relation.

#### -Publisher:

Publisher				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	Varchar	20	Primary key, not null	
Publisher_Name				
- Fname	varchar	20		
- Mname	varchar	6		
- Lname	varchar	20		
Address	varchar	50		
<del>Phone_no</del>	<del>varchar</del>	<del>20</del>	<del>not null</del>	
<del>E-mail</del>	<del>varchar</del>	<del>30</del>		

For Publisher relation, Publisher\_id can be a primary key and phone\_no can have none or more values. Hence keeping the separate table for publisher\_phone no and e-mail can also have none or more values, hence keeping a separate table for Publisher\_e-mail.

#### -Publisher\_phone\_no:

Publisher_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	varchar	20	Composite key, not null	publisher
<b>Phone no</b>	varchar	20	Composite key, not null	

Publisher\_phone\_no is in 1NF and publisher\_id and phone\_no can be a composite key for this relation.

#### -Publisher\_e-mail:

Publisher_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	varchar	20	Composite key, not null	publisher
<b>E-mail</b>	varchar	20	Composite key, not null	

Publisher\_e-mail is in 1NF and publisher\_id and E-mail can be a composite key for this relation.

#### -Books:

Books
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Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Book_id</b>	varchar	20	Primary key, not null	
Title	varchar	40	not null	
Isbn	varchar	15	Unique key, not null	
Publisher_id	varchar	15	Foreign key, not null	
Published_year	date			
Edition	varchar	15		
Price	numeric	(6,2)		
Count	Int	3		

Book\_id can be a primary key and no attribute will have nonatomic value.

#### -Author\_Books:

Author_Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Book_id</b>	varchar	20	Composite key, Foreign key, not null	Delete on cascade
<b>Author_id</b>	varchar	20	Composite key, Foreign key, not null	Delete on cascade

Author\_books relates author and book relations. Both book\_id and author\_id can be a composite key. No attributes will have nonatomic value.

#### -Category:

Category				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Category_id</b>	varchar	20	Primary key, not null	
Category_name	varchar	30		
Category_description	varchar	40		

Category\_id can be a primary key and no attribute will have nonatomic value.

#### -Borrower:

Borrower				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower_id</b>	varchar	20	Primary key, not null	
Name				
- Fname	varchar	20		
- Mname	varchar	6		
- Lname	varchar	20		

Gender	char	1	not null, Check(Gender='m' or Gender='f')	
DOB	date			
Address	varchar	50		
Phone_no	varchar	20	not null	
E-mail	varchar	30		

For Borrower relation, Borrower\_id can be a primary key and phone\_no can have none or more values. Hence keeping the separate table for Borrower\_phone no and e-mail can also have none or more values, hence keeping a separate table for Borrower\_e-mail.

#### **-Borrower\_phone\_no:**

Borrower_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower_id</b>	varchar	20	Composite key, not null	Borrower
<b>Phone_no</b>	varchar	20	Composite key, not null	

Borrower\_phone\_no is in 1NF and Borrower\_id and phone\_no can be a composite key for this relation.

#### **-Borrower\_e-mail:**

Borrower_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower_id</b>	varchar	20	Composite Key, not null	Borrower
<b>E-mail</b>	varchar	20	Composite key, not null	

Borrower\_e-mail is in 1NF and Borrower\_id and E-mail can be a composite key for this relation.

#### **-Library\_staff:**

Library_staff				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Librarian_id</b>	varchar	20	Primary key, not null	
Name				
- Fname	varchar	20		
- Mname	varchar	6		
- Lname	varchar	20		
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
Admin	char	1	Check(Admin='y' or Admin='n')	

Librarian\_id can be a primary key and no attribute will have nonatomic value.

**-Book\_Lending:**

Book_Lending				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Lending_id</b>	varchar	20	Composite key, not null	
<b>Fee_id</b>	varchar	20	Composite key, not null	
Borrower_id	varchar	20	Foreign key, not null	Delete on cascade
Book_id	varchar	20	Foreign key, not null	Delete on cascade
Issue_date	timestamp			
Due_date	timestamp			
Return_date	timestamp			
Issued_by	varchar	20	Foreign key, not null	Delete on cascade
Collected_by	varchar	20	Foreign key, not null	Delete on cascade
Amount	numeric	(6,2)		

Lending\_id and Fee\_id can be a composite key and no attribute will have nonatomic value.

**2NF:**

A table is in 2NF if:

It is in 1NF and

It includes no partial dependencies; that is, no attribute is dependent on only a portion of the primary key.

(It is still possible for a table in 2NF to exhibit transitive dependency; that is, one or more attributes may be functionally dependent on non-key attributes.)

**-Author:**

Author				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Address	varchar	50		

The relation is already in 2NF. Hence, no changes.

**-Author\_phone\_no:**

Author_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Composite key, not null	Author
<b>Phone no</b>	varchar	20	Composite key, not null	

The relation is already in 2NF. Hence, no changes.

**-Author\_e-mail:**

Author_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Composite key, not null	Author
<b>E-mail</b>	varchar	20	Composite key, not null	

The relation is already in 2NF. Hence, no changes.

**-Publisher:**

Publisher				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	Varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Address	varchar	50		

The relation is already in 2NF. Hence, no changes.

**-Publisher\_phone\_no:**

Publisher_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	varchar	20	Composite key, not null	publisher
<b>Phone no</b>	varchar	20	Composite key, not null	

The relation is already in 2NF. Hence, no changes.

**-Publisher\_e-mail:**

Publisher_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	varchar	20	Composite key, not null	publisher
<b>E-mail</b>	varchar	20	Composite key, not null	

The relation is already in 2NF. Hence, no changes.

**-Books:**

Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Book id</b>	varchar	20	Primary key, not null	
Title	varchar	40	not null	
Isbn	varchar	15	Unique key, not null	
Publisher id	varchar	15	Foreign key, not null	
Published year	date			
Edition	varchar	15		
Price	numeric	(6,2)		
Count	Int	3		

The relation is already in 2NF. Hence, no changes.

**-Author\_Books:**

Author_Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Book id</b>	varchar	20	Composite key, Foreign key, not null	Delete on cascade
<b>Author id</b>	varchar	20	Composite key, Foreign key, not null	Delete on cascade

The relation is already in 2NF. Hence, no changes.

**-Category:**

Category				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Category id</b>	varchar	20	Primary key, not null	
Category name	varchar	30		
Category description	varchar	40		

The relation is already in 2NF. Hence, no changes.

**-Borrower:**

Borrower				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower id</b>	varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
DOB	date			

Address	varchar	50		
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The relation is already in 2NF. Hence, no changes.

#### **-Borrower\_phone\_no:**

Borrower_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower id</b>	varchar	20	Composite key, not null	Borrower
<b>Phone no</b>	varchar	20	Composite key, not null	

The relation is already in 2NF. Hence, no changes.

#### **-Borrower\_e-mail:**

Borrower_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower id</b>	varchar	20	Composite Key, not null	Borrower
<b>E-mail</b>	varchar	20	Composite key, not null	

The relation is already in 2NF. Hence, no changes.

#### **-Library\_staff:**

Library_staff				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Librarian id</b>	varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
Admin	char	1	Check(Admin='y' or Admin='n')	

The relation is already in 2NF. Hence, no changes.

#### **-Book\_Lending:**

Book_Lending				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Lending id</b>	varchar	20	Primary key, not null	
<b>Fee_id</b>	varchar	20	Composite key, not null	
<b>Borrower id</b>	varchar	20	Foreign key, not null	Delete on cascade

Book_id	varchar	20	Foreign key, not null	Delete on cascade
Issue_date	timestamp			
Due_date	timestamp			
Return_date	timestamp			
Issued_by	varchar	20	Foreign key, not null	Delete on cascade
Collected_by	varchar	20	Foreign key, not null	Delete on cascade
Amount	numeric	(6,2)		

For Book\_lending relation, Lending\_id is the primary key and Borrower\_id and Book\_id are only related to lending\_id completely and cannot be related to fee\_id. Also Since there can be many empty records for fee\_id if the book is returned by the due\_date and so moving fee\_id and amount to another table titled late-fee. The relation is in 2NF.

#### **-Late\_fee**

Late_fee				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Fee_id</b>	varchar	20	Primary Key, not null	
Lending_id	varchar	20	Foreign key, not null	Book_lending
Amount	numeric	(6,2)		

For late\_fee relation, Fee\_id is the primary key and lending\_id is the foreign key and the relation is in 2NF.

#### **3NF:**

A table is in Third Normal Form (3NF) if:

It is in 2NF and

It contains no transitive dependencies.

#### **-Author:**

Author				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Address	varchar	50		

The relation is already in 3NF. Hence, no changes.

#### **-Author\_phone\_no:**



Author_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Composite key, not null	Author
<b>Phone no</b>	varchar	20	Composite key, not null	

The relation is already in 3NF. Hence, no changes.

**-Author\_e-mail:**

Author_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Author_id</b>	varchar	20	Composite key, not null	Author
<b>E-mail</b>	varchar	20	Composite key, not null	

The relation is already in 3NF. Hence, no changes.

**-Publisher:**

Publisher				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	Varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Address	varchar	50		

The relation is already in 3NF. Hence, no changes.

**-Publisher\_phone\_no:**

Publisher_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	varchar	20	Composite key, not null	publisher
<b>Phone no</b>	varchar	20	Composite key, not null	

The relation is already in 3NF. Hence, no changes.

**-Publisher\_e-mail:**

Publisher_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Publisher_id</b>	varchar	20	Composite key, not null	publisher
<b>E-mail</b>	varchar	20	Composite key, not null	

The relation is already in 3NF. Hence, no changes.

**-Books:**

Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Book id</b>	varchar	20	Primary key, not null	
Title	varchar	40	not null	
Isbn	varchar	15	Unique key, not null	
Publisher id	varchar	15	Foreign key, not null	
Published year	date			
Edition	varchar	15		
Price	numeric	(6,2)		
Count	Int	3		

The relation is already in 3NF. Hence, no changes.

**-Author\_Books:**

Author_Books				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Book id</b>	varchar	20	Composite key, Foreign key, not null	Delete on cascade
<b>Author id</b>	varchar	20	Composite key, Foreign key, not null	Delete on cascade

The relation is already in 3NF. Hence, no changes.

**-Category:**

Category				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Category id</b>	varchar	20	Primary key, not null	
Category name	varchar	30		
Category description	varchar	40		

The relation is already in 3NF. Hence, no changes.

**-Borrower:**

Borrower				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower id</b>	varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
DOB	date			

Address	varchar	50		
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The relation is already in 3NF. Hence, no changes.

#### **-Borrower\_phone\_no:**

Borrower_phone_no				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower_id</b>	varchar	20	Composite key, not null	Borrower
<b>Phone no</b>	varchar	20	Composite key, not null	

The relation is already in 3NF. Hence, no changes.

#### **-Borrower\_e-mail:**

Borrower_e-mail				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Borrower_id</b>	varchar	20	Composite Key, not null	Borrower
<b>E-mail</b>	varchar	20	Composite key, not null	

The relation is already in 3NF. Hence, no changes.

#### **-Library\_staff:**

Library_staff				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Librarian_id</b>	varchar	20	Primary key, not null	
Fname	varchar	20		
Mname	varchar	6		
Lname	varchar	20		
Gender	char	1	not null, Check(Gender='m' or Gender='f')	
Admin	char	1	Check(Admin='y' or Admin='n')	

The relation is already in 3NF. Hence, no changes.

#### **-Book\_Lending:**

Book_Lending				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Lending_id</b>	varchar	20	Primary key, not null	
Borrower_id	varchar	20	Foreign key, not null	Delete on cascade
Book_id	varchar	20	Foreign key, not null	Delete on cascade
Issue_date	timestamp			
Due_date	timestamp			

Return date	timestamp			
Issued by	varchar	20	Foreign key, not null	Delete on cascade
Collected by	varchar	20	Foreign key, not null	Delete on cascade

The relation is already in 3NF. Hence, no changes.

#### **-Late\_fee**

Late_fee				
Attribute Name	Data Type	Size	Constraints	Cascading Problems
<b>Fee_id</b>	varchar	20	Primary Key, not null	
Lending_id	varchar	20	Foreign key, not null	Book lending
Amount	numeric	(6,2)		

The relation is already in 3NF. Hence, no changes.

### **Implementation of the relations in the Database:**

#### **-Author:**

```
create table Author (Author_id varchar(20) not null, Fname varchar (20), Mname varchar (6),Lname varchar(20), Address varchar(50), primary key (Author_id));
```

#### **-Author\_phone\_no:**

```
create table Author_phone_no (Author_id varchar(20) not null, Phone_no varchar(20) not null,primary key (Author_id,Phone_no),foreign key(Author_id) references Author(Author_id) on delete cascade);
```

#### **-Author\_Email:**

```
create table Author_Email (Author_id varchar(20) not null, Email varchar(20) not null,primary key (Author_id,Email),foreign key(Author_id) references Author(Author_id) on delete cascade);
```

#### **-Publisher:**

```
create table Publisher (Publisher_id varchar(20) not null, Fname varchar (20), Mname varchar (6),Lname varchar(20), Address varchar(50), primary key (Publisher_id));
```

#### **-Publisher\_phone\_no:**

create table Publisher\_phone\_no (Publisher\_id varchar(20) not null, Phone\_no varchar(20) not null,primary key (Publisher\_id,Phone\_no),foreign key(Publisher\_id) references Publisher(Publisher\_id) on delete cascade);

**-Publisher\_Email:**

create table Publisher\_Email (Publisher\_id varchar(20) not null, Email varchar(20) not null,primary key (Publisher\_id,Email),foreign key(Publisher\_id) references Publisher(Publisher\_id) on delete cascade);

**-Books:**

create table Books (Book\_id varchar(20) not null,Title varchar(40) not null,Isbn varchar(15) not null,Publisher\_id varchar(15) not null,Published\_year date,Edition Varchar(15),Price numeric(6,2),Count int,primary key(Book\_id),Unique(Isbn),foreign key(Publisher\_id) references Publisher(Publisher\_id) on delete cascade);

**-Author\_Books:**

create table Author\_Books (Book\_id varchar(20) not null,Author\_id varchar(20) not null,primary key(Book\_id,Author\_id),foreign key(Book\_id) references Books(Book\_id) on delete cascade,foreign key(Author\_id) references Author(Author\_id) on delete cascade);

**-Category:**

create table Category(Category\_id varchar(20) not null,Category\_name varchar(30),Category\_description varchar(40),primary key(Category\_id));

**-Borrower:**

create table Borrower (Borrower\_id varchar(20) not null, Fname varchar (20), Mname varchar (6),Lname varchar(20),Gender char(1) Check(Gender='m' or Gender='f') not null,DOB date,Address varchar(50), primary key (Borrower\_id));

**-Borrower\_phone\_no:**

create table Borrower\_phone\_no (Borrower\_id varchar(20) not null, Phone\_no varchar(20) not null,primary key (Borrower\_id,Phone\_no),foreign key(Borrower\_id) references Borrower(Borrower\_id) on delete cascade);

**-Borrower\_Email:**

create table Borrower\_Email (Borrower\_id varchar(20) not null, Email varchar(20) not null, primary key (Borrower\_id, Email), foreign key (Borrower\_id) references Borrower (Borrower\_id) on delete cascade);

**-Library\_staff:**

create table Library\_staff (Librarian\_id varchar(20) not null, Fname varchar (20), Mname varchar (6), Lname varchar(20), Gender char(1) Check (Gender='m' or Gender='f') not null, Admin char(1) Check (Admin='y' or Admin='n'), primary key (Librarian\_id));

**-Book\_Lending:**

create table Book\_Lending (Lending\_id varchar(20) not null, Borrower\_id varchar(20) not null, Book\_id varchar(20) not null, Issue\_date timestamp, Due\_date timestamp, Return\_date timestamp, Issued\_by varchar(20) not null, Collected\_by varchar(20) not null, primary key (Lending\_id), foreign key (Borrower\_id) references Borrower (Borrower\_id) on delete cascade, foreign key (Book\_id) references Books (Book\_id) on delete cascade, foreign key (Issued\_by) references Library\_staff (Librarian\_id) on delete cascade, foreign key (Collected\_by) references Library\_staff (Librarian\_id) on delete cascade);

**-Late\_fee:**

create table Late\_fee (Fee\_id varchar(20) not null, Lending\_id varchar(20) not null, Amount numeric(6,2), primary key (Fee\_id), foreign key (Lending\_id) references Book\_lending (Lending\_id) on delete cascade);

**Insertion of tuples into the relations:****-Author:**

insert into Author values ('11001', 'Ram', 'C', 'Bose', 'No-160, Bleeker st, NJ-07037');

insert into Author values ('11002', 'Sam', 'W', 'Sebastin', 'No-180, South st, NJ-07037');

insert into Author values ('11003', 'Mark', 'S', 'Jones', 'No-20, River st, NJ-07030');

insert into Author values ('11004', 'William', 'R', 'Shakespeare', 'No-71, 42 st, NY-10165');

insert into Author values ('11005', 'Richard', 'A', 'Kevin', 'No-131, 15 st, NY-10161');

insert into Author values ('11006', 'kim', 'L', 'Jacob', 'No-1, Madison st, NJ-07030');

insert into Author values ('11007', 'Roger', 'A', 'Stevens', 'No-56, Jfk ave, NJ-07037');

**-Author\_phone\_no:**

```
insert into Author_phone_no values('11001','2018729456');
```

```
insert into Author_phone_no values('11002','5518737856');
```

```
insert into Author_phone_no values('11003','5519038725');
```

```
insert into Author_phone_no values('11004','7183476598');
```

```
insert into Author_phone_no values('11005','3478795124');
```

```
insert into Author_phone_no values('11006','2019127612');
```

```
insert into Author_phone_no values('11007','5512936518');
```

```
insert into Author_phone_no values('11007','2017486132');
```

**-Author\_Email:**

```
insert into Author_Email values('11001','Rambose@gmail.com');
```

```
insert into Author_Email values('11002','samseb@hotmail.com');
```

```
insert into Author_Email values('11003','markjon@gmail.com');
```

```
insert into Author_Email values('11004','williamsh@gmail.com');
```

```
insert into Author_Email values('11005','richardkev@gmail.com');
```

```
insert into Author_Email values('11006','kimjac@gmail.com');
```

```
insert into Author_Email values('11006','kimj@hotmail.com');
```

```
insert into Author_Email values('11007','rogstev@hotmail.com');
```

**-Publisher:**

```
insert into Publisher values('100001','Mcgraw','H','Hill','No-6,Central st,NJ-07037');
```

```
insert into Publisher values('100002','Andy','J','Sommers','No-46,Booraem ave,NJ-07037');
```

```
insert into Publisher values('100003','Parin','B','devilliers','No-33,new York ave,NJ-07030');
```

```
insert into Publisher values('100004','Stein','A','stones','No-21,34 st,NY-10187');
```

```
insert into Publisher values('100005','Ricky','U','Wiley','No-45,71 st,NY-10763');
```

```
insert into Publisher values('100006','Michael','P','Rector','No-35,Rhodes ave,NJ-07030');
```

**-Publisher\_phone\_no:**

insert into Publisher\_phone\_no values('100001','2018672156');

insert into Publisher\_phone\_no values('100002','5518778936');

insert into Publisher\_phone\_no values('100003','5514803215');

insert into Publisher\_phone\_no values('100004','7185783728');

insert into Publisher\_phone\_no values('100005','3473035712');

insert into Publisher\_phone\_no values('100006','2019264652');

insert into Publisher\_phone\_no values('100006','5510102931');

**-Publisher\_e-mail:**

insert into Publisher\_Email values('100001','mcgrawh@gmail.com');

insert into Publisher\_Email values('100002','andyso@hotmail.com');

insert into Publisher\_Email values('100003','paride@gmail.com');

insert into Publisher\_Email values('100004','steins@gmail.com');

insert into Publisher\_Email values('100005','rickyw@gmail.com');

insert into Publisher\_Email values('100005','rick@hotmail.com');

insert into Publisher\_Email values('100006','Michr@hotmail.com');

**-Books:**

insert into Books values('101','Java Concepts','9783456721','100001','2010-04-17','4','150.00','8');

insert into Books values('102','Probability Theory','9476456721','100002','2009-05-18','5','100.00','6');

insert into Books values('103','Julius Caesar','9002456721','100003','2012-08-05','1','85.00','5');

insert into Books values('104','The Lean Startup','9946720145','100004','2010-05-02','3','120.00','6');

insert into Books values('105','Quantum Physics','9556816721','100005','2010-10-28','4','90.00','4');

insert into Books values('106','World War 2','9210237271','100006','2014-12-13','2','100.00','9');



**-Author\_Books:**

insert into Author\_Books values('101','11005');

insert into Author\_Books values('101','11006');

insert into Author\_Books values('102','11001');

insert into Author\_Books values('103','11004');

insert into Author\_Books values('104','11001');

insert into Author\_Books values('105','11003');

insert into Author\_Books values('106','11002');

**-Category:**

insert into Category values('1','Computer Science','An in-depth view of computers');

insert into Category values('2','Mathematics','About integration and probability');

insert into Category values('3','English Literature','Ranging from past to present novels');

insert into Category values('4','Business','From business policies to start ups');

insert into Category values('5','Physics','Insights into various laws of nature');

insert into Category values('6','History','The past happening of human civilization');

**-Borrower:**

insert into Borrower values('983412','rebecca','L','Tony','f','1990-09-16','No-15,Gates ave,NJ-07030');

insert into Borrower values('983413','robin','V','persie','m','1993-11-28','No-5,jones ave,NJ-07037');

insert into Borrower values('983414','martin','H','guptil','m','1994-08-10','No-145,Park ave,NJ-07030');

insert into Borrower values('983415','lucy','E','james','f','1992-02-04','No-83,Clinton st,NJ-07030');

insert into Borrower values('983416','morgan','S','Joseph','m','1988-05-20','No-67,56 st,NY-10220');

**-Borrower\_phone\_no:**

```
insert into Borrower_phone_no values('983412','2013729256');
```

```
insert into Borrower_phone_no values('983413','2017938876');
```

```
insert into Borrower_phone_no values('983414','2016739872');
```

```
insert into Borrower_phone_no values('983415','2012938476');
```

```
insert into Borrower_phone_no values('983416','2013376964');
```

```
insert into Borrower_phone_no values('983416','3476892836');
```

**-Borrower\_Email:**

```
insert into Borrower_Email values('983412','rebeccalt@gmail.com');
```

```
insert into Borrower_Email values('983413','robinvp@gmail.com');
```

```
insert into Borrower_Email values('983414','martinhg@gmail.com');
```

```
insert into Borrower_Email values('983415','lucyej@gmail.com');
```

```
insert into Borrower_Email values('983415','lucyjam@hotmail.com');
```

```
insert into Borrower_Email values('983416','morgansj@gmail.com');
```

**-Library\_staff:**

```
insert into Library_staff values('726389169','James','S','Mckenzie','m','y');
```

```
insert into Library_staff values('746388165','Mary','J','Thomas','f','y');
```

```
insert into Library_staff values('786319264','Dennis','U','Ritchie','m','n');
```

```
insert into Library_staff values('702389153','Hamilton','A','Jean','m','n');
```

```
insert into Library_staff values('753584139','Jane','E','Walker','f','n');
```

**-Book\_Lending:**

```
insert into Book_Lending values('9845203785','983412','102','2017-4-10 10:09:00','2017-4-17 10:09:00','2017-4-15 12:01:00','786319264','702389153');
```

```
insert into Book_Lending values('9945213765','983413','103','2017-4-15 12:09:00','2017-4-22 12:09:00','2017-4-21 14:19:00','753584139','702389153');
```

```
insert into Book_Lending values('9645234517','983414','104', '2017-4-10 14:09:00', '2017-4-17 14:09:00', '2017-4-15 16:49:00', '702389153','753584139');
```

```
insert into Book_Lending values('9274679826','983415','105', '2017-4-13 15:09:00', '2017-4-20 15:09:00', '2017-4-21 18:35:00', '746388165','746388165');
```

```
insert into Book_Lending values('9067235467','983415','106', '2017-3-17 18:09:00', '2017-3-24 18:09:00', '2017-3-23 11:23:00', '726389169','702389153');
```

```
insert into Book_Lending values('9392019293','983416','101', '2017-2-12 09:40:00', '2017-2-19 09:40:00', '2017-3-12 10:00:00', '753584139','786319264');
```

```
insert into Book_Lending values('9203045639','983416','104', '2017-3-19 11:40:00', '2017-3-26 11:40:00', '2017-3-29 12:00:00', '753584139','786319264');
```

#### **-Late\_fee:**

```
insert into Late_fee values('67238','9274679826','01.50');
```

```
insert into Late_fee values('69323','9392019293','45.00');
```

```
insert into Late_fee values('68586','9203045639','04.50');
```

### **SQL queries:**

#### **1.Students/Professors**

**1.Display the book title,Isbn and publisher name for book id=101**

```
Select Title,Isbn,Fname,Mname,Lname
```

```
From Books B,Publisher P
```

```
Where Book_id='101' and B.Publisher_id=P.Publisher_id;
```

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```
140
141
142
143
144
145
146
147
148
149
150
151
152
153
154 select Title,Isbn,Fname,Mname,Lname
155 From Books B,Publisher P
156 where book_id='101' and B.publisher_id=P.publisher_id;
157
```

Data Output Explain Messages History

	title character varyi...	isbn character varyi...	fname character varyi...	mname character varyi...	lname character varyi...
<input type="checkbox"/>	Java Concepts	9783456721	Mcgraw	H	Hill

2.Display the issue date and due date for the book borrowed by borrower lname- 'james'

Select Issue\_date,Due\_date

From Book\_Lending B

Where Borrower\_id=( Select Borrower\_id

From Borrower A

Where A.Lname='james');

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```

165
166
167
168
169
170 Select Issue_date,Due_date
171 From Book_Lending B
172 Where Borrower_id=(Select Borrower_id
173 From Borrower A
174 Where A.Lname='james');
175
176
177
178
179
180
181

```

Data Output Explain Messages History

	issue_date timestamp without time z...	due_date timestamp without time z...
<input type="checkbox"/>	2017-04-13 15:09:00	2017-04-20 15:09:00
<input type="checkbox"/>	2017-03-17 18:09:00	2017-03-24 18:09:00

3.Display the borrower\_id and the number of times the borrower has borrowed books using the borrower phone\_no- '3476892836'

Select L.Borrower\_id,Count(P.Borrower\_id) As No\_Times\_Borrowed

From Book\_Lending L,Borrower\_Phone\_no P

Where P.phone\_no='3476892836' and P.Borrower\_id=L.Borrower\_id

group by L.Borrower\_id;

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```

30
31
32
33
34
35
36
37 Select L.Borrower_id,Count(P.Borrower_id) As No_Times_Borrowed
38 From Book_Lending L,Borrower_Phone_no P
39 Where P.phone_no='3476892836' and P.Borrower_id=L.Borrower_id
40 group by L.Borrower_id;
41

```

Data Output Explain Messages History

	borrower_id character varying (20)	no_times... bigint
<input type="checkbox"/>	983416	2

**2.Library staff/Librarian**

1.Display the book\_id and net sum(amount) based on book\_id that has passed the due date

Select sum(amount) As Total\_Amount,Book\_id

From Late\_fee L,Book\_Lending B

Where L.Lending\_id=B.Lending\_id and Return\_date>Due\_Date

Group by Book\_id

Order by Book\_id asc;

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```

4
5 Select Book_id,sum(amount) As Total_Amount
6 From Late_fee L,Book_Lending B
7 Where L.Lending_id=B.Lending_id and Return_date>Due_Date
8 Group by Book_id
9 order by Book_id asc;

```

Data Output Explain Messages History

	book_id character varying (20)	total_amo... numeric
<input type="checkbox"/>	101	45.00
<input type="checkbox"/>	104	4.50
<input type="checkbox"/>	105	1.50

2.Update the borrower phone\_no of borrower\_id-983413

Update Borrower\_phone\_no

set Phone\_no='2016098427'

where Borrower\_id='983413';

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```

182
183
184
185
186
187
188
189
190
191
192
193
194
195
196 Update Borrower_phone_no set Phone_no='2016098427' where Borrower_id='983413';
197
198 select *from Borrower_Phone_no;
199

```

Data Output Explain Messages History

	borrower_id character varying (20)	phone_no character varying (20)
<input type="checkbox"/>	983412	2013729256
<input type="checkbox"/>	983414	2016739872
<input type="checkbox"/>	983415	2012938476
<input type="checkbox"/>	983416	2013376964
<input type="checkbox"/>	983416	3476892836
<input type="checkbox"/>	983413	2016098427

3. Display the name,gender and address of the borrower who returned the book after the due date

Select Distinct Fname,Mname,Lname,Gender,Address

From Borrower B,Book\_Lending L

Where Return\_date>Due\_date and L.Borrower\_id=B.Borrower\_id;

College library database on postgres@PostgreSQL 9.6

```

13
14
15
16
17
18
19 Select Distinct Fname,Mname,Lname,Gender,Address
20 From Borrower B,Book_Lending L
21 Where Return_date>Due_date and L.Borrower_id=B.Borrower_id;
22
23
24

```

Data Output Explain Messages History

<input type="checkbox"/>	fname character varying (20)	mname character varying (6)	lname character varying (20)	gender character (1)	address character varying (50)
<input type="checkbox"/>	lucy	E	james	f	No-83,Clinton st,NJ-070
<input type="checkbox"/>	morgan	S	Joseph	m	No-67,56 st,NY-10220

### 3.Author/Publisher

1.Display the names of all publishers who have worked with an author

```

Select P.Fname,P.Mname,P.Lname
From Publisher P
Where P.publisher_id in(Select B.publisher_id
From Author_Books A,Books B
Where A.Book_id=B.Book_id);

```

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```

45
46
47 Select P.Fname,P.Mname,P.Lname
48 From Publisher P
49 Where P.publisher_id in(Select B.publisher_id
50 From Author_Books A,Books B
51 Where A.Book_id = B.Book_id);
52
53
54
55
56

```

Data Output Explain Messages History

<input type="checkbox"/>	fname character varying (20)	mname character varying (6)	lname character varying (20)
<input type="checkbox"/>	Mcgraw	H	Hill
<input type="checkbox"/>	Andy	J	Sommers
<input type="checkbox"/>	Parin	B	devilliers
<input type="checkbox"/>	Stein	A	stones
<input type="checkbox"/>	Ricky	U	Wiley
<input type="checkbox"/>	Michael	P	Rector



2.Display the book\_id's and the number of times each book was borrowed from most borrowed to least borrowed

Select book\_id,count(book\_id) as Times\_Borrowed  
 From book\_lending  
 Group by Book\_id  
 Order by Times\_borrowed desc;

College library database on postgres@PostgreSQL 9.6

```

7
8
9
10 select book_id,count(book_id) as Times_Borrowed from book_lending group by Book_id order by Times_borrowed de
11
12
13
14
15
16
17

```

book_id	times_bor...
104	2
103	1
101	1
105	1
102	1
106	1

3.Display the publisher\_id and published\_year for the books that were issued between 1<sup>st</sup> march and 30<sup>th</sup> march, 2017.

Select distinct Publisher\_id,published\_year  
 From Book\_lending B,Books H  
 Where issue\_date between '2017-03-01 00:00:00' and '2017-03-30 00:00:00'  
 and B.book\_id=H.book\_id;

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```
28  
29  
30  
31  
32  
33  
34 select distinct Publisher_id,published_year from Book_lending B,Books H where issue_date between '2017-03-01 0  
35  
36  
37  
38
```

Data Output Explain Messages History

<input type="checkbox"/>	<b>publisher_id</b> character varying (15)	<b>published_year</b> date	
<input type="checkbox"/>	100004	2010-05-02	
<input type="checkbox"/>	100006	2014-12-13	