IE 6700

USE CASE STUDY REPORT

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Executive Summary:

The purpose of this case study is design and implement a relational database and apply the fundamental concepts of database management into the real-life scenario. For this project, we will focus on library system which is a really common scenario in the real life, and everybody must deal with this system at least once in his or her life. We hope through conceptual data modeling, mapping the conceptual model, implementation of relation model and some data visualizations to let the readers have a better understanding towards the rental book system which includes what kinds of databases should be stored within the system and how each database connects together.

Designing a library management system looks easy but it may not. A good library information management system is built as do all the housekeeping things of a library, like storing and updating student information, books information, rental records, return records and sorts of that. All those requirements encourage us to design a system with the following requirements:

1. All the members are enabled to search books by typing any one of those attributes: ID, ISBN, book name, author id, author name, book type or publisher.
2. The librarians should be able to access all the students' information by typing any one of those attributes: student ID, name, gender, email address or card number.
3. All the members can search the comments of a book by keyword so that they can pick the books by readers' reviews.
4. The system also needs to set some constraints, like the maximum number of books per member can rent, the longest period per member can keep one book, the number of copies a book can have and sorts of that.
5. The system should be also able to trigger notifications to librarians and members.

In the following body of report, we will introduce our database design, database implementation and addressed business problems in a straightforward and insightful way.

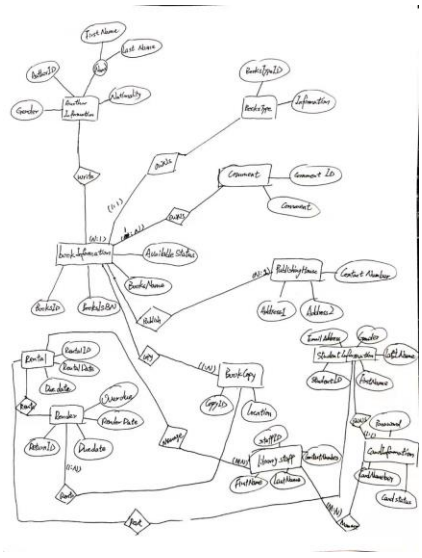
I. Introduction

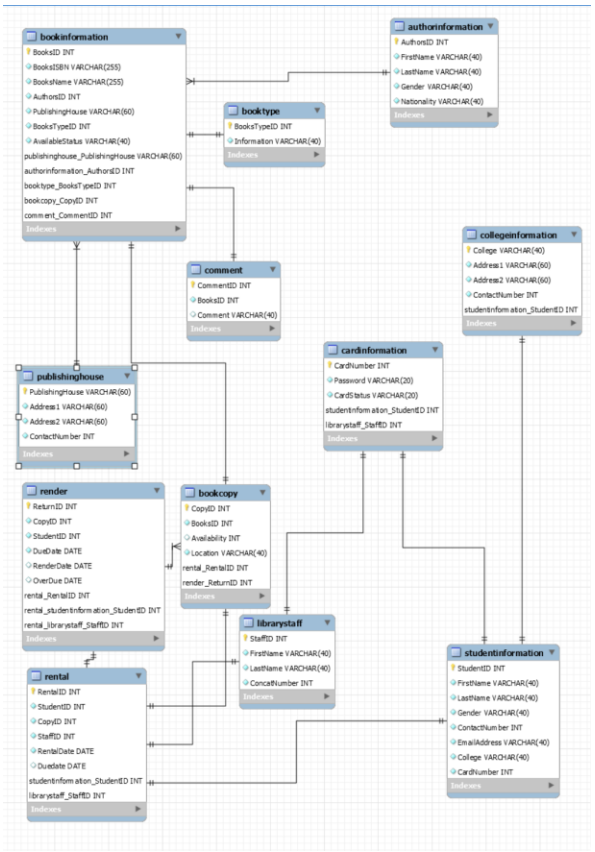
Since the 17th century, library science has been existed as an independent interdisciplinary subject. Although very few people go to library currently, library science is still a necessary disciplinary existing in academic area. Information system as one of the most important branches in library science. For this project, we will focus on building a good library database management system which can do some simple searches about books, students and comments.

In this report, there are five main parts, the conceptual data modeling part will contain EER diagram and UML diagram. Then, we will introduce our relational model, and implement some SQL queries. Lastly, we will introduce some visualizations to talk about the insights and possible addressed business problems in a further step.

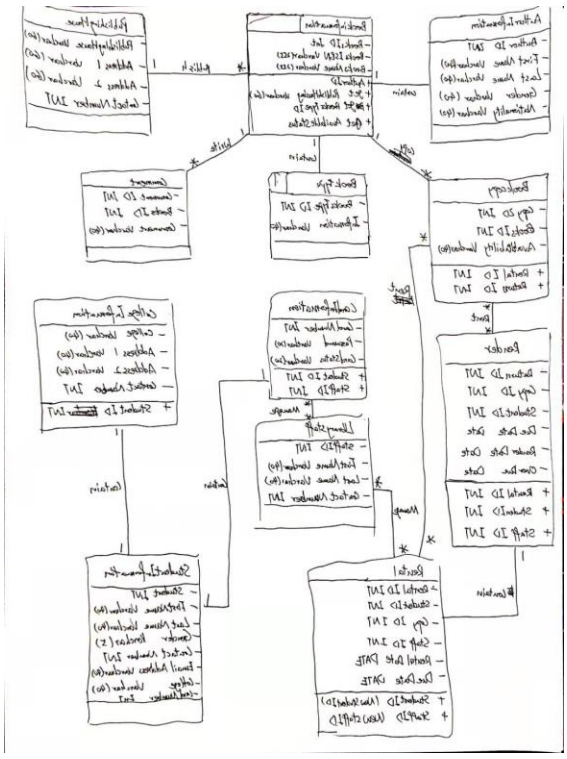
II. Conceptual Data Modeling

1. EER Diagram





2. UML Diagram



III. Mapping Conceptual Model to Relational Model

Relational Model

Comment(CommentID, *BooksID*, Comment)

BookInformation(BooksID, BooksISBN, BooksName, *AuthorsID*, PublishingHouse, *BooksTypeId*, AvailableStatus)

BookCopy(CopyID, *BooksID*, Availability, Location)

FOREIGN KEY BooksID refers to BooksID in BookisInformation; NULL NOT ALLOWED

FOREIGN KEY AuthorsID refers to AuthosID in AuthorsInformation; NULL NOT ALLOWED

FOREIGN KEY PublishingHouse refers to PublishingHouse in PublishingHouse; NULL NOT ALLOWED

FOREIGN KEY BooksTypeID refers to BooksTypeID in BooksType; NULL NOT ALLOWED

AuthorsInformaiton(AuthorsID, FirstName, LastName, Gender, Nationality)

BookType(BookstypeID, Information)

PublishingHouse(PublishingHouse, Address1, Address2, ContactNumber)

libraryStaff(StaffID, FirstName, LastName, ContactNumber)

Render (ReturnID, *CopyID, StudentID*, Duedate, RenderDate, Overdue)

Rental (RentalID, *StudentID, CopyID, StaffID*, RentalDate, Duedate)

SudentInformation(StudentID, FirstName, LastName, Gender, ContactNumber, EmailAddress. *College, CardNumber*)

CardInformation (CardNumber, Password, CardStatus)

CollegeInformation(College, Address1, Address2, ContactNumber)

FOREIGN KEY CopyID refers to CopyID in BookCopy; NULL NOT ALLOWED

FOREIGN KEY StudentID refers to StudentID in StudentInformation; NULL NOT ALLOWED

FOREIGN KEY StaffID refers to StaffID in LibraryStaff; NULL NOT ALLOWED

FOREIGN KEY College refers to College in CollegeInformation; NULL NOT ALLOWED

FOREIGN KEY CardNumber refers to CardNumber in CardInformation; NULL NOT ALLOWED

IV. Implementation of Relation Model via MySQL and NoSQL

- **Query 1:**

```
-- Query 1: Find a book's Name and its Author Name which ISBN is 9780128235508
SELECT a.FirstName, a.LastName, b.BooksName
FROM book.authorinformation AS a
INNER JOIN book.bookinformation AS b
ON b.AuthorsID = a.AuthorsID
WHERE b.BooksISBN = '9780128235508';
```

Result:

FirstName	LastName	BooksName
Alessio	Pipinato	Innovative Bridge Design Handbook

- **Query 2:**

```
-- Query 2: Find the U.S Author's name and their Book's name
SELECT ai.FirstName, ai.LastName, bi.BooksName
FROM book.AuthorInformation ai
INNER JOIN Book.BookInformation bi
ON bi.AuthorsID = ai.AuthorsID
WHERE ai.Nationality = 'U.S.';
```

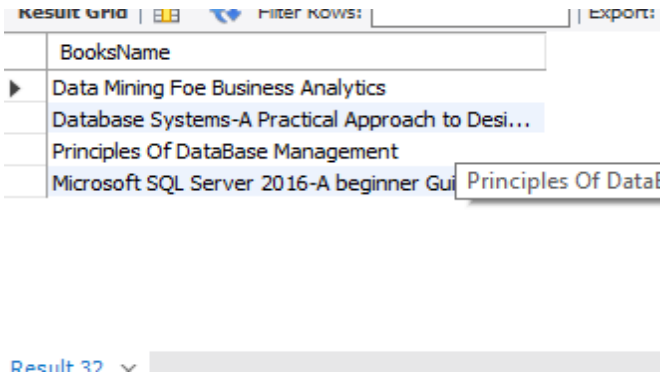
Result:

FirstName	LastName	BooksName
Alan	Moore	The Killing Joke
Mark	Waid	Kingdom Come
Alessio	Pipinato	Innovative Bridge Design Handbook
Thomas	Connoly	Database Systems-A Practical Approach to Desi...
Richard	Daft	Management

- **Query 3:**

```sql
-- Query 3: Find some books about computer application
SELECT bi.BooksName
FROM book.BookInformation bi
INNER JOIN Book.Booktype bt
ON bi.BooksTypeID = bt.BooksTypeID
WHERE bt.Information = 'Computer Application';
```

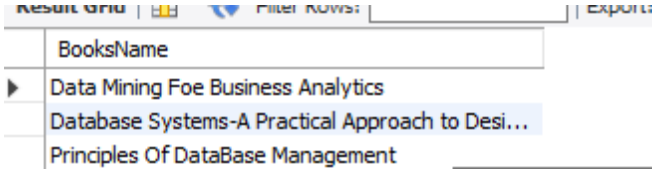
Result:



- **Query 4:**

```sql
437  -- Query 4: Find some books which names contain 'Data' and show user the author name of these books
438  SELECT bi.BooksName, ai.FirstName, ai.lastName
439  FROM book.BookInformation bi
440  INNER JOIN book.authorinformation AS ai
441  ON bi.AuthorsID = ai.AuthorsID
442  WHERE bi.BooksName LIKE '%Data%';
```

Result:



- **Query 5:**

```sql
-- Query 5: Given Card Number to find student's name
SELECT si.FirstName, si.LastName, si.EmailAddress
FROM student.studentinformation as si
INNER JOIN student.cardinformation as sc
ON sc.CardNumber = si.CardNumber
WHERE sc.CardNumber = '12341';
```

Result:

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

FirstName	LastName	EmailAddress
John	Wick	jw@gmail.com

- **Query 6:**

```sql
-- Query 6: Given student ID to find student's name and college
SELECT FirstName, LastName, College
FROM student.studentinformation
WHERE StudentID = '2103';
```

Result:

Result Grid | Filter Rows:

FirstName	LastName	College
Trever	Philips	CS

- **Query 7:**

```sql
-- Query 7: Given staff ID to find the student ID which rent books from him
SELECT rr.StudentID
FROM rental.rental AS rr
INNER JOIN rental.librarystaff AS rl
ON rl.StaffID  = rr.StaffID
WHERE rl.StaffID = '112';
```

Result:

Result Grid | Filter Rows:

StudentID
2102
2102

Query 8: List all books' name and their books' type, author's name

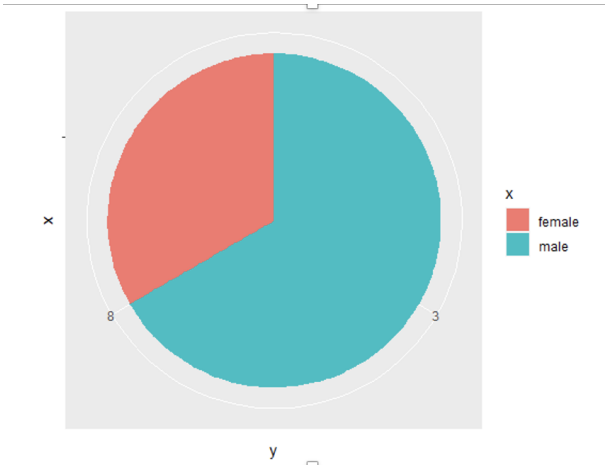
```
57 •  SELECT a.FirstName, a.LastName, a.Gender, b.BooksName, bt.Information
58    FROM book.authorinformation AS a
59    INNER JOIN book.bookinformation AS b
60    ON b.AuthorsID = a.AuthorsID
61    INNER JOIN book.booktype as bt
62    ON bt.BooksTypeID = b.BooksTypeID;
```

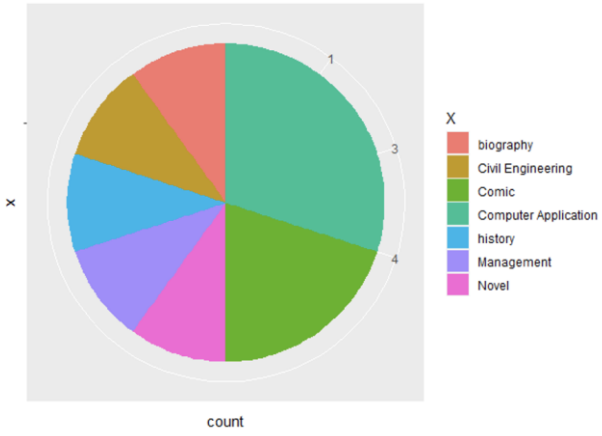
esult Grid | Filter Rows: | Export: | Wrap Cell Content:

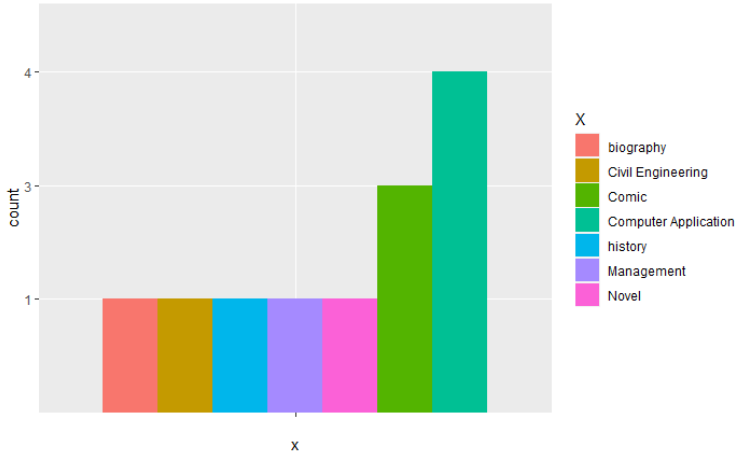
FirstName	LastName	Gender	BooksName	Information
Alan	Moore	Male	The Killing Joke	Comic
Mark	Waid	Male	Kingdom Come	Comic
Junji	Ito	Male	No Longer Human	Comic
Alessio	Pipinato	Female	Data Mining Foe Business Analytics	Computer Application
Alessio	Pipinato	Male	Innovative Bridge Design Handbook	Civil Engineering
Thomas	Connoly	Male	Database Systems-A Practical Approach to Desi...	Computer Application
Wilfried	Lemahieu	Male	Principles Of DataBase Management	Computer Application
Richard	Daft	Male	Management	Management
NAHIROBY	BELTRE	FeMale	MUJER IMPORTANTE E INFLUYENTE	history
Hull	Janet	FeMale	THE DAY THE TURKEY CAME TO SCHOOL	Novel

V. Data Visualization via R

The database is accessed using R and visualization of analyzed data is shown below. In our little library, computer applications books and comic book are the top two categories, maybe the students study hard and needs the assistance of comic books to relax themselves. Next, we also analysis the gender distribution of authors, males write more books than females, one possible reason is we have more computer tools books in our library instead of female authors' preference books.







VI. Summary and Insights

Design and implement a relational library database are a fun thing. We can integrate as many as the dataset we want into one large functional database system, in our case, we involve in book information, publisher information, students information, author information, college information and rental records so that we can automated the daily activities which occur in the library, includes renting books to students, recording and updating the details of each rental records and sorts of that. However, our system is still too simple to process complicated requirements. Our next goal is adding some constraints, like setting the limit number of books each member can borrow, and also trigger notifications to remind the members to return the books. Lots of insights can be found from library resources. To provide efficient services, we need higher data quality and more datasets involve in this.