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INTRODUCTION TO DATABASE.

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1 Introduction

The growth of DBMS across different sectors including Finance, Healthcare, Education, and E-Commerce has seen a phenomenal positive trend. This popularization is mostly a result of technological innovations that empower institutions to optimize operations of data acquisition and storage by putting up effective systems and platforms. Thus organizations get the chance to increase their production capacities, improve the accuracy of their completed tasks, and simplify the operation of data handling procedures.

The DBMS alleviates the need for the employment of an even highly paid expert such as an engineer or a web developer as the DBMS enables easy creation, modification, deletion, and replacement of a database. Given that, these members usually interact with platforms like MySQL, SQL Management Studio, and so on to do these functions. Database management systems (DBMS) perform a role in both commercial and personal applications because of their wide range where the raw data is turned to be information and available for decision-making when that decision-making process is needed.

This manuscript looks at the pros and cons related to DBMSs versus traditional file-based systems as a way to break down these systems to understand their use and why they are preferred. It specifically deals with issues like data change, truthfulness, or safety. Additionally, an overview of DBMS features is presented; these include data retrieval, storage, etc. This will be finalized with a comprehensive E-Library Management system case study that is proposed for Kuala Lumpur.

Along with the case study, the essays main idea will be to bring forth how the DBMS can improve accuracy and effectiveness in librarians work by implementing these strategies. It will also provide details of how one can improve the organizational strength and progress through the use of DBMS.

2 Database and Database Management System.

2.1 The advantages of Database and DBMS.

- **Data Abstraction and Independence:** Databases involve the abstraction of the data and the independence of the data. This means data is presented easily so users do not need to know where the data is in the system. (Watt, 2014)
- **Data Security:** With the use of a DBMS, data security is elevated as the memory is centralized for several users to access it but they can only operate that information in a controlled way to guarantee that the data is safe and updated. (Mullins, 2023)
- **Efficient Data Handling:** A DBMS is an effective tool to reconcile requests from multiple applications that use the same data without creating much delay on either side, and also provides recovery from mistakes and errors, data integrity, and an almost standard API. (Mullins, 2023)
- **Scalability and Flexibility:** An organization can bank on DBMS in case it has to modify systems due to changes in business requirements. The new data can be easily related to the existing system without hampering the existing structure and adding scalability. (Mullins, 2023)
- **Economy of Scale:** Database systems drill down to gain economies of scale for the high volume data processes efficiently since they are optimized for the so big data sets, hence they are cost-friendly for managing the large data sets. (Mullins, 2023)
- **Multiple Views of Data:** However, DBMS by the nature of its own allows multiple database views, which helps many users to have different perspectives about database schema generally, therefore ensuring a high level of usability and adaptability to various user needs. (Watt, 2014)

2.2 The functions of DBMS.

1. Efficient Data Storage and Organization: Our library is equipped with over 2000 books across various categories, and its database, fueled by a robust DBMS, acts as a virtual knowledge base wherein all necessary information about authors/titles/genres/categories/etc are well-classified and nicely arranged/arranged in a clean and organized manner. Through developing the process how librarians can track the book type and ensure availability when members demand it. Further, it is the DBMS that helps oversee the handling of different versions of the same book, assigning unique ISBN codes despite possessing the same ISBN. This will prevent multiple applications for the same copy from the same people and boost book availability.

2. Backup and Recovery Management: The role of the DBMS is to insulate the library from potential damage to its weighty data by maintaining its completeness and integrity. If the system has errors or failures in general, the secondary backup and recovery system comes into action automatically, for not losing data like books lend, fine details, and member activity. This guarantees the uninterrupted flow of library services without the occurrence of data loss or corruption that may be a nuisance when tracing overdue books and reservation of lending shelves.

3. Data Transformation and Presentation: Upon using data alteration procedures, DBMS will emphasize the task of converting raw data into regular formats, and therefore simplicity of access and comprehension of information will be promoted among librarians. To illustrate, the disambiguation of same-title books by their ISBNs enables the simplification and streamlining of cataloging and retrieval, thus solving the difficulties faced in libraries with similar textbooks. At the moment, librarians can be swift by tracking a particular edition or copies, which is considered to have strengthened the entire flow of book management processes.

4. Data Dictionary Management: In the library's database, the DBMS serves as a guardian, putting in order data component objects and their relationships so that there is only one data element and it is consistent with the rest. A good example is the process whereby books are coded as green-tagged, red-tagged, and yellow-tagged. This process is managed under data dictionary, and this guarantees the rigorous implementation of loans policy and minimizes applicable grace periods. The data dictionary provided with the instructions helps members to manage their reservations and fines within deadlines thereby making the membership a great experience for our customers.

2.3 The disadvantages of file-based systems.

In the context of the library case study, utilizing file-based systems for managing library operations presents several drawbacks:

- **Data Redundancy:** Diversity in file-based systems entails having the repeated data being hosted in various files and folders which are scattered across systems and places. In the library situation, this could result in inconsistencies of book data listed, for example, duplicated titles of the same book or different status of loan across the various files.
- **Data Inconsistency:** As a result of the fact that file systems are centralized, keeping data synchronization functional is a great challenge. When data changes or modifications are performed, these handlings are spread to all the relevant files. The copies of files may allow incorrect things to appear in such situations. To be more precise, had an instance book had its loan status reflected in one set of files and not in the rest others, librarians might encounter the problems of ascertaining its availability.
- **Limited Data Integrity:** Records of type one are built without in-built rules for resolving conflicts of data integrity. Centralized control is vital to data integrity. Otherwise, vulnerabilities such as mishandling and hacking may arise. In library conditions, one may fail to create the network required for the safe-guarding of lost book records, hence messing up the quality of accurate and reliable database of the library is a challenge.
- **Limited Scalability:** As a rule, there is not much headroom for the growing quantity and scope of systems on a file basis. When a library starts to widen its collection and/or the base of members, the challenge of managing a vast number of files grows in parallel. The process of searching for or updating the data about books can create a situation with performance issues and inefficiencies. This fact can be very complicated for the library and can make it unable to meet the existing or growing demands.
- **Difficulty in Data Retrieval and Analysis:** There is a tendency to point to a file-based system and have a feeling of not being able to retrieve data fast enough and under the given circumstances, it might take some time. Lack of standardized data structures and search capabilities can complicate their tasks by creating obstacles in drawing useful conclusions, or producing data output on books lent, members activity, or overdue fines. This hampers the process of decision-making of the library and thereby undermines the optimal functioning of its operations.

3 Business Rules and Normalization.

3.1 Business rules:

- Each member can borrow a maximum of 10 books at a time.
- Only 15 percent of the books are out on loan at any time.
- Every loan must include a loan date and a return date that clarifies when it was borrowed and when it should be returned.
- Fines are incurred for overdue books based on the books category and the number of days overdue.
- Books with different categories (yellow-tagged, red-tagged, or green-tagged) have different loan periods.
- Books such as reference books, journals, and student projects, cannot be loaned out.
- Books can be easily identified by their International Standard Book Number (ISBN).
- Members can look up information about each book, including author, title, genre, and category.
- Members can reserve books that are currently on loan, and they will be notified when the books become available.
- Members can book presentation rooms for discussion purposes.
- Members must book presentation rooms one day ahead.
- Members are limited to one booking per week per member.

3.2 NORMALIZATION:

3.2.1 UNF

UNF PART 1											
ISBN	Member ID	Member_FirstName	Member_LastName	Member_Gender	Member_ContactInfo	MemberEmail	Member_Address	Membership_Status	Editions	BookID	CopiesID
ISBN0001	M001	John	Doc	Male	555-123-4567	john@email.com	123 Main St, KL	ACTIVE	1	B001	Cop001
ISBN0002	M002	Alice	Johnson	Female	555-987-6543	alice@email.com	456 Oak Ave, Penang	ACTIVE	2	B002	Cop002
ISBN00278	M003	Emily	Williams	Female	555-321-7890	emily@email.com	789 Cedar Rd, Kuala Lumpur	ACTIVE	1	B003	Cop001
ISBN00279	M004	David	Smith	Male	555-555-1234	david@email.com	234 Elm St, Kuala Lumpur	INACTIVE	1	B004	Cop001
ISBN00280	M005	Sarah	Brown	Female	555-345-6789	sarah@email.com	567 Pine Ave, Kuala Lumpur	INACTIVE	1	B005	Cop001
ISBN00281	M006	Rachel	Hilmer	Female	555-987-6543	rachel@email.com	456 Elm St, Kuala Lumpur	ACTIVE	1	B006	Cop001
ISBN00282	M007	Michael	Taylor	Male	555-321-7890	michael@email.com	567 Oak St, Kuala Lumpur	INACTIVE	1	B007	Cop001
UNF PART 2											
Book Title	Author	Description	Book_category	Category_Fine_Daily_Amount	Book_genre	Loan_ID	Lend_status	Book_Status	ReservationID	Room_ID	Room_Name
The Great Gatsby	F. Scott Fitzgerald	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.	Red	RM2	Fiction	L001	Yes	Returned	Record001	Room001	PresentationRoomA
The Great Gatsby	F. Scott Fitzgerald	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.	Red	RM2	Fiction	L002	No	Lent	Record002	Room002	PresentationRoomB
Harry Potter and the Sorcerer's Stone	J.K. Rowling	It tells the story of an 11-year-old orphan named Harry Potter who discovers he is a wizard and is invited to attend Hogwarts School of Witchcraft and Wizardry.	Yellow	RM3	Fantasy	L003	No	Already reserved	Record003	Room003	PresentationRoomC
Pride and Prejudice	Jane Austen	It follows the story of Elizabeth Bennet, one of five sisters from a middle-class family, as she navigates the social landscape of her time.	Yellow	RM3	Romance	L004	No	Already reserved	Record004	Room001	PresentationRoomA
1984	George Orwell	It depicts a future where a totalitarian society controls people through surveillance and propaganda.	Yellow	RM3	Dystopian	L005	No	Lent	Record005	Room003	PresentationRoomC
The Catcher in the Rye	J.D. Salinger	It details two days in the life of 16-year-old Holden Caulfield after he has been expelled from prep school.	Green	RM2	Fiction	L006	Yes	Available	Record006	Room002	PresentationRoomB
The Lord of the Rings	John Ronald Reuel Tolkien	A hobbit named Frodo inherits the One Ring, which can destroy the entire world.	Green	RM4	Fantasy	L007	Yes	Available	Record007	Room001	PresentationRoomA
UNF PART 3											
Booking Time	Room_reservation_date	presentation_room	Status(Booking/Cancel)	PublisherID	Publisher_Name	Publisher_Address	Book_Reservation_Date	Pickup_date	Return_date		
2024.05.11 08:30:00	2024.05.11	RoomA	Cancel	P001	Acme Publishers	456 Elm St, Kuala Lumpur	2024.05.10	2024.05.11	2024.05.15		
2024.05.11 08:30:00	2024.05.11	RoomB	Booking	P002	XYZ Publishers	7789 Pine Blvd, Kuala Lumpur	2024.05.10	2024.05.11	2024.05.16		
2024.05.12 08:20:00	2024.05.12	RoomC	Booking	P001	Acme Publishers	456 Elm St, Kuala Lumpur	2024.05.10	2024.05.12	2024.06.17		
2024.05.13 12:20:00	2024.05.13	RoomA	Booking	P003	Vista Publishers	456 Sentul, Kuala Lumpur	2024.05.11	2024.05.13	2024.06.18		
2024.05.14 15:20:00	2024.05.14	RoomC	Booking	P001	Acme Publishers	456 Elm St, Kuala Lumpur	2024.05.14	2024.05.14	2024.06.19		
2024.05.15 21:50:00	2024.05.15	RoomB	Booking	P002	XYZ Publishers	7789 Pine Blvd, Kuala Lumpur	2024.05.10	2024.05.15	2024.06.20		
2024.05.16 08:20:00	2024.05.16	RoomA	Booking	P003	Vista Publishers	456 Sentul, Kuala Lumpur	2024.05.15	2024.05.16	2024.06.21		

TABLE 1 : UNF

The Unnormalized Form (UNF) table for the E-Library Database System is made as a rough work which cannot be implemented in a real database due to it being unstructured and denormalized data. Here's a description of the table:

Table: **E-Library**

Table data elements:

ISBN, Member ID, Member_FirstName, Member_LastName, Member_Gender, Member_ContactInfo, MemberEmail, Member_Address, Membership_Status, Editions, Book ID, CopiesID, Author, Description, Book_category, Category Fine Daily Amount, Book_genre, Loan ID, Lend_status, Book_Status, ReservationID, Room ID, Room Name, Room_reservation_date, presentation room Status(Booking/Cancel), PublisherID, Publisher_Name, Publisher_Address, Book_Reservation_Date, Pickup_date, Return_date

3.2.2 1NF- Flattening Table

To convert a table from UNF to 1NF we must insure that:

- Each row is unique.
- No cell has more than one value
- There are no repeating groups.

For rules 1 and 3, it was already true. However, for rule 2 we had to separate the addresses for member and publisher into "Street" and "city".

1NF PART 1											
ISBN	Member ID	Member_FirstName	Member_LastName	Member_Gender	Member_ContactInfo	MemberEmail	Member_Street	Member_City	Membership_Status	Editions	BookID
ISBN0001	M001	John	Doc	Male	555-123-4567	john@email.com	123 Main St	Kuala Lumpur	ACTIVE	1	B001
ISBN0002	M002	Alice	Johnson	Female	555-987-6543	alice@email.com	456 Oak Ave	Penang	ACTIVE	2	B002
ISBN00278	M003	Emily	Williams	Female	555-321-7890	emily@email.com	789 Cedar Rd	Kuala Lumpur	ACTIVE	1	B003
ISBN00279	M004	David	Smith	Male	555-555-1234	david@email.com	234 Elm St	Kuala Lumpur	INACTIVE	1	B004
ISBN00280	M005	Sarah	Brown	Female	555-345-6789	sarah@email.com	567 Pine Ave	Kuala Lumpur	INACTIVE	1	B005
ISBN00281	M006	Rachel	Hilmer	Female	555-987-6543	rachel@email.com	456 Elm St	Kuala Lumpur	ACTIVE	1	B006
ISBN00282	M007	Michael	Taylor	Male	555-321-7890	michael@email.com	567 Oak St	Kuala Lumpur	INACTIVE	1	B007
1NF PART 2											
CopiesID	Book Title	Author	Description	Book_category	Category_Fine_Daily_Amount	Book_genre	Loan_ID	Lend_status	Book_Status	ReservationID	Room_ID
Cop001	The Great Gatsby	F. Scott Fitzgerald	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.	Red	RM2	Fiction	L001	Yes	Returned	Record001	Room001
Cop002	The Great Gatsby	F. Scott Fitzgerald	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.	Red	RM2	Fiction	L002	No	Lent	Record002	Room002
Cop003	Harry Potter and the Sorcerer's Stone	J.K. Rowling	It tells the story of an 11-year-old orphan named Harry Potter who discovers he is a wizard and is invited to attend Hogwarts School of Witchcraft and Wizardry.	Yellow	RM3	Fantasy	L003	No	Already reserved	Record003	Room003
Cop004	Pride and Prejudice	Jane Austen	It follows the story of Elizabeth Bennet, one of five sisters from a middle-class family, as she navigates the social landscape of her time.	Yellow	RM3	Romance	L004	No	Already reserved	Record004	Room001
Cop005	1984	George Orwell	It depicts a future where a totalitarian society controls people through surveillance and propaganda.	Yellow	RM3	Dystopian	L005	No	Lent	Record005	Room003
Cop006	The Catcher in the Rye	J.D. Salinger	It details two days in the life of 16-year-old Holden Caulfield after he has been expelled from prep school.	Green	RM2	Fiction	L006	Yes	Available	Record006	Room002
Cop007	The Lord of the Rings	John Ronald Reuel Tolkien	A hobbit named Frodo inherits the One Ring, which can destroy the entire world.	Green	RM4	Fantasy	L007	Yes	Available	Record007	Room001
1NF PART 3											
Room Name	Booking Time	Room_reservation_date	Room_Status	PublisherID	Publisher_Name	Publisher_Street	Publisher_City	Book_Reservation_Date	Pickup_date	Return_date	
Presentation Room A	2024.05.11 22:30:00	2024.05.11	Cancel	P001	Acme Publishers	456 Elm St	Kuala Lumpur	2024.05.10	2024.05.11	2024.05.15	
Presentation Room B	2024.05.11 22:30:00	2024.05.11	Booking	P002	XYZ Publishers	7789 Pine Blvd	Kuala Lumpur	2024.05.10	2024.05.11	2024.06.16	
Presentation Room C	2024.05.12 08:20:00	2024.05.12	Booking	P001	Acme Publishers	456 Elm St	Kuala Lumpur	2024.05.10	2024.05.12	2024.06.17	
Presentation Room A	2024.05.13 12:20:00	2024.05.13	Booking	P003	Vista Publishers	456 Sentul	Kuala Lumpur	2024.05.11	2024.05.13	2024.06.18	
Presentation Room C	2024.05.14 15:20:00	2024.05.14	Booking	P001	Acme Publishers	456 Elm St	Kuala Lumpur	2024.05.11	2024.05.14	2024.06.19	
Presentation Room B	2024.05.15 21:50:00	2024.05.15	Booking	P002	XYZ Publishers	7789 Pine Blvd	Kuala Lumpur	2024.05.10	2024.05.15	2024.06.20	
Presentation Room A	2024.05.16 08:20:00	2024.05.16	Booking	P003	Vista Publishers	456 Sentul	Kuala Lumpur	2024.05.15	2024.05.16	2024.06.21	

TABLE 2 : 1NF

Full dependencies:

- OrderID -> MemberID, BookID, ManagerID, PublisherID, ReviewID, OrderDate, DeliveryStatus, CartID, PaymentID
- MemberID -> Member_FirstName, Member_LastName, Member_Street, Member_City, Member_ContactNo, Member_Email
- ManagerID -> Manager_Name, Manager_Street, Manager_City
- BookID -> Book_Title, Book_Genre, Deposit
- PublisherID -> Publisher_Name, Publisher_Street, Publisher_City
- ReviewID -> Rating, ReviewText

Partial dependencies:

- MemberID and LoanID -> Pickup_date + Return_date

In this dependency, "MemberID" and "LoanID" together determine the "Pickup_date" and "Return_date". This means that for a specific loan taken by a particular member, you can find out the return date and the pickup date. However, neither "Pickup_date" nor "Return_date" is dependent on "LoanID" alone, and its not dependent on "MemberID" alone either. It requires both values to be determined.

- BookID and PublisherID -> Edition

In this dependency, "BookID" and "PublisherID" together determine the "Edition". This means, "BookID" and "PublisherID" are determined by "Edition". However, "Edition" is not dependent on "BookID" alone, and its not dependent on "PublisherID" alone either. It requires both values to be determined. (same sense can be applied to the points below)

- BookID and PublisherID -> Author
- BookID and PublisherID -> Book_Reservation_Date
- RoomID and ReservationID -> BookingTime

Primary key:

The primary key (PK) of the 1NF table is a combination of LoanID and BookID.

3.2.3 2NF- Removing Partial Dependency

- Members Table (**Member ID**, Loan ID, Member_FirstName, Member_LastName, Member_ContactInfo, MemberEmail, Member_Street, Member_City, Member_Gender, Pickup_date, Return_date, Category Fine Daily Amount, Membership_Status)
- Books Table (**BookID**, PublisherID, Editions, Author, Book_Reservation_Date, Lend_status, Book_genre, Book_category, Book_Title, Description, CopiesID, ISBN, Book_Status, Publisher_Name, Publisher_Street, Publisher_City)
- Rooms Table (**Room ID**, Room Name, ReservationID, Booking Time, Room_reservation_date, Room-Status)

2NF MEMBER TABLE													
Member ID	Loan ID	Member_FirstName	Member_LastName	Member_ContactInfo	MemberEmail	Member_Street	Member_City	Member_Gender	Pickup_date	Return_date	Category	Fine Daily Amount	Membership_Status
M001	L001	John	Doe	555-123-4567	john@email.com	123 Main St	Kuala Lumpur	Male	2024.05.11	2024.05.15	RM2		ACTIVE
M002	L002	Alice	Johnson	555-987-6543	alice@email.com	456 Oak Ave	Penang	Female	2024.05.11	2024.06.16	RM2		ACTIVE
M003	L003	Emily	Williams	555-321-7890	emily@email.com	789 Cedar Rd	Kuala Lumpur	Female	2024.05.12	2024.06.17	RM3		ACTIVE
M004	L004	David	Smith	555-555-1234	david@email.com	234 Elm St	Kuala Lumpur	Male	2024.05.13	2024.06.18	RM3		INACTIVE
M005	L005	Sarah	Brown	555-345-6789	sarah@email.com	345 Pine Ave	Kuala Lumpur	Male	2024.05.14	2024.06.19	RM3		INACTIVE
M006	L006	Rachel	Miller	555-987-6543	rachel@email.com	456 Elm St	Kuala Lumpur	Female	2024.05.15	2024.06.20	RM2		ACTIVE
M007	L007	Michael	Taylor	555-321-7890	michael@email.com	567 Oak St	Kuala Lumpur	Male	2024.05.16	2024.06.21	RM4		INACTIVE

TABLE 3 :2NF MEMBERS TABLE

2NF BOOKS TABLE															
Book ID	PublishedID	Editions	Author	Book_Reservation_Date	Lend_status	Book_genre	Book_category	Book_Title	Description	CopiesID	ISBN	Book_Status	Publisher_Name	Publisher_Street	Publisher_City
B001	P001	1	F. Scott Fitzgerald	2024.05.10	Yes	Fiction	Red	The Great Gatsby	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.	Copy001	ISBN0001	Returned	Acme Publishers	456 Elm St	Kuala Lumpur
B002	P002	2	F. Scott Fitzgerald	2024.05.10	No	Fiction	Red	The Great Gatsby	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.	Copy002	ISBN0001	Lent	X/Y Publishers	789 Pine Blvd	Kuala Lumpur
B003	P001	1	J.K. Rowling	2024.05.10	No	Fantasy	Yellow	Harry Potter and the Sorcerer's Stone	It tells the story of an 11-year-old orphan named Harry Potter who discovers he is a wizard and is invited to attend Hogwarts School of Witchcraft and Wizardry.	Copy001	ISBN0278	Already reserved	Acme Publishers	456 Elm St	Kuala Lumpur
B004	P003	1	Jane Austen	2024.05.11	No	Romance	Yellow	Pride and Prejudice	It follows the story of Elizabeth Bennet, one of five sisters from a middle-class family, as she navigates the social landscape of her time.	Copy001	ISBN0279	Already reserved	Vista Publishers	456 Sentul	Kuala Lumpur
B005	P001	1	George Orwell	2024.05.11	No	Dystopian	Yellow	1984	It depicts a future where a totalitarian society controls people through surveillance and propaganda.	Copy001	ISBN0280	Lent	Acme Publishers	456 Elm St	Kuala Lumpur
B006	P002	1	J.D. Salinger	2024.05.10	Yes	Fiction	Green	The Catcher in the Rye	It details two days in the life of 15-year-old Holden Caulfield, who has been expelled from prep school.	Copy001	ISBN0281	Available	X/Y Publishers	789 Pine Blvd	Kuala Lumpur
B007	P003	1	J.R.R. Tolkien	2024.05.15	Yes	Fantasy	Green	The Lord of the Rings	A hobbit named Frodo inherits the One Ring, which can destroy the entire world.	Copy001	ISBN0282	Available	Vista Publishers	456 Sentul	Kuala Lumpur

TABLE 4 :2NF BOOKS TABLE

2NF ROOM'S TABLE						
Room ID	Room Name	ReservationID	Booking Time	Room_reservation_date	Room-Status	
Room001	Presentation Room A	Record001	2024.05.11. 22:30:00	2024.05.11	Cancel	
Room002	Presentation Room B	Record002	2024.05.11. 22:33:00	2024.05.11	Booking	
Room003	Presentation Room C	Record003	2024.05.12. 08:20:00	2024.05.12	Booking	
Room001	Presentation Room A	Record004	2024.05.13. 12:20:00	2024.05.13	Booking	
Room003	Presentation Room C	Record005	2024.05.14. 15:20:00	2024.05.14	Booking	
Room002	Presentation Room B	Record006	2024.05.15. 21:50:00	2024.05.15	Booking	
Room001	Presentation Room A	Record007	2024.05.16. 08:20:00	2024.05.16	Booking	

TABLE 5 :2NF ROOMS TABLE

The transformation to 2NF resolves the anomaly of “partial dependencies” in the 1NF design. In the 2NF design, each table has a unique primary key that identifies its records.

The **Member Table** combines MemberID and LoanID as composite primary keys, This ensures that all information related to loans is tied to LoanID and MemberID which also deletes partial dependencies.

However, the **Book Table** uses BookID as the primary key, which links all book details, as well as publisher information with the BookID which also deletes partial dependencies.

The **Rooms Table** now uses RoomID as the primary key, unifying all room-related attributes, and makes all Reservations-related information directly linked to RoomID which also deletes partial dependencies.

In summary, the 2NF structure eliminates partial dependencies.

3.2.4 3NF – Removing Transitive Dependency

- Members table(**Member ID**, Member_FirstName, Member_LastName, Member_Gender, Member_ContactInfo, MemberEmail, Member_Street, Member_City, Membership_Status)
- Loans table(**Loan ID**, Member ID, Book ID, Reservation_Date, Pickup_date, Return_date, Book_Status)
- Books table(**BookID**, ISBN, Editions, CopiesID, Author, Category Fine Daily Amount, Available_Loan, Book_genre, Book_category, Book_Title, PublisherID, Description)
- Publishers table(**PublisherID**, Publisher_Name, Publisher_Street, Publisher_City)
- Copies table(**CopiesID**, ISBN, Book_Status)
- Rooms table(**Room ID**, Room Name)
- Reservations table(**ReservationID**, Member ID, Room ID, Booking Time, Room_reservation_date, Room-Status)

Transitive dependency occurs when a non-key attribute is dependent on another attribute, which in turn is dependent on the primary key. This creates an indirect dependency that can lead to redundancy in data.

In the 2NF tables, the transitive dependencies that exist are as follows:

1. In the "2NF BOOK TABLE," there is a transitive dependency between "BookID" and the attributes related to the publisher information (e.g., "PublisherID," "Publisher_Name," "Publisher_Street," "Publisher_City, "). These attributes are indirectly dependent on "BookID" through the "PublisherID".
2. In the "2NF Member's Table," there is a transitive dependency between "Loan ID" and the attributes related to the pickup and return dates. These attributes are indirectly dependent on "Loan ID" through "MemberID," which is not a candidate key.

To eliminate these dependencies and achieve 3NF, the tables have been changed as follows:

In the 3NF tables:

1. The "2NF BOOK TABLE" is divided into three separate tables: "3NF Publisher TABLE", "3NF BOOK TABLE" and "3NF COPIES TABLE". The transitive dependency between "BookID" and the publisher details is now fixed. Now, the "Publisher" information is directly linked to "BookID" in the "3NF BOOK TABLE".
2. In the "2NF Member's Table," the transitive dependency between "BookID" and the book details has been also fixed(deleted). The "Book" details are directly linked to "BookID," and the "Loan" information is connected to "BookID" through a foreign key relationship, creating a more normalized structure.

Foreign Keys:

1. In the "3NF Publisher TABLE," the "BookID" column serves as a FK(foreign key), referencing the primary key of the "3NF BOOK TABLE."
2. In the "3NF BOOK TABLE," the "PublisherID" and "CopiesID" columns act as a foreign keys, referencing the primary key of the "3NF Publisher TABLE" and "3NF COPIES TABLE"
3. In the "3NF Members TABLE," there are no foreign keys, as this table represents member information and does not reference other tables.
4. In the "3NF Loan's Table," the "MemberID" and "BookID" columns serve as foreign keys, referencing the primary keys of the "3NF Members TABLE" and "3NF BOOK TABLE,".
5. In the "3NF reservation's TABLE," the "MemberID," and "RoomID" columns act as foreign keys, referencing the primary keys of the "3NF Members TABLE" and "3NF Room's Table".

These FK relationships maintain and ensures that data in one table corresponds to data that is valid in the related tables.

3NF MEMBER'S TABLE									
Member ID PK	Member FirstName	Member LastName	Member Gender	Member ContactInfo	MemberEmail	Member Street	Member City	Membership Status	
M001	John	Doe	Male	555-123-4567	john@email.com	123 Main St	Kuala Lumpur	ACTIVE	
M002	Alice	Johnson	Female	555-987-6543	alice@email.com	456 Oak Ave	Penang	ACTIVE	
M003	Emily	Williams	Female	555-321-7890	emily@email.com	789 Cedar Rd	Kuala Lumpur	ACTIVE	
M004	David	Smith	Male	555-555-1234	david@email.com	234 Elm St	Kuala Lumpur	INACTIVE	
M005	Sarah	Brown	Female	555-345-6789	sarah@email.com	345 Pine Ave	Kuala Lumpur	INACTIVE	
M006	Rachel	Mitter	Female	555-987-6543	rachel@email.com	456 Elm St	Kuala Lumpur	ACTIVE	
M007	Michael	Taylor	Male	555-321-7890	michael@email.com	567 Oak St	Kuala Lumpur	INACTIVE	

TABLE 6 :3NF MEMBERS TABLE

3NF LOAN'S TABLE						
Loan ID PK	Member ID FK	Book ID FK	Reservation Date	Pickup date	Return date	Book Status
L001	M001	B001	2024.05.10	2024.05.11	2024.05.15	Returned
L002	M002	B002	2024.05.10	2024.05.11	2024.06.16	Lent
L003	M003	B003	2024.05.10	2024.05.12	2024.06.17	Already reserved
L004	M004	B004	2024.05.11	2024.05.13	2024.06.18	Already reserved
L005	M005	B005	2024.05.11	2024.05.14	2024.06.19	Lent
L006	M006	B006	2024.05.10	2024.05.15	2024.06.20	Available
L007	M007	B007	2024.05.15	2024.05.16	2024.06.21	Available

TABLE 7 :3NF LOAN'S TABLE

3NF BOOKS TABLE												
BookID PK	ISBN	Editions	CopiesID FK	Author	Category	Fine/DailyAmount	Available Loan	Book centre	Book category	Book Title	PublisherID FK	Description
B001	ISBN0001	1	Copy001	F. Scott Fitzgerald	RH2		Yes	Fiction	Red	The Great Gatsby	P001	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.
B002	ISBN0002	2	Copy002	F. Scott Fitzgerald	RH2		No	Fiction	Red	The Great Gatsby	P002	It tells the story of Jay Gatsby, a self-made millionaire, and his pursuit of Daisy Buchanan, a wealthy young woman whom he loved in his youth.
B003	ISBN0278	1	Copy001	J.K. Rowling	RH3		No	Fantasy	Yellow	Harry Potter and the Sorcerer's Stone	P001	It tells the story of an 11-year-old orphan named Harry Potter who discovers he is a wizard and is invited to attend Hogwarts School of Witchcraft and Wizardry.
B004	ISBN0279	1	Copy001	Jane Austen	RH3		No	Romance	Yellow	Pride and Prejudice	P003	It follows the story of Elizabeth Bennet, one of five sisters from a middle-class family, as she navigates the social landscape of her time.
B005	ISBN0280	1	Copy001	George Orwell	RH3		No	Dystopian	Yellow	1984	P001	It depicts a future where a totalitarian society controls people through surveillance and propaganda.
B006	ISBN0281	1	Copy001	J. D. Salinger	RH2		Yes	Fiction	Green	The Catcher in the Rye	P002	It details two days in the life of 16-year-old Holden Caulfield after he has been expelled from prep school.
B007	ISBN0282	1	Copy001	John Ronald Reuel Tolkien	RH4		Yes	Fantasy	Green	The Lord of the Rings	P003	A hobbit named Frodo inherits the One Ring, which can destroy the entire world.

TABLE 8 :3NF BOOKS TABLE

3NF PUBLISHER'S TABLE			
PublisherID PK	Publisher Name	Publisher Street	Publisher City
P001	Acme Publishers	456 Elm St	Kuala Lumpur
P002	XYZ Publishers	7789 Pine Blvd	Kuala Lumpur
P001	Acme Publishers	456 Elm St	Kuala Lumpur
P003	Vista Publishers	456 Sentul	Kuala Lumpur
P001	Acme Publishers	456 Elm St	Kuala Lumpur
P002	XYZ Publishers	7789 Pine Blvd	Kuala Lumpur
P003	Vista Publishers	456 Sentul	Kuala Lumpur

TABLE 9 :3NF PUBLISHER TABLE

3NF COPIES TABLE		
CopiesID PK	ISBN	Book Status
Copy001	ISBN0001	Returned
Copy002	ISBN0001	Lent
Copy001	ISBN0278	Already reserved
Copy001	ISBN0279	Already reserved
Copy001	ISBN0280	Lent
Copy001	ISBN0281	Available
Copy001	ISBN0282	Available

TABLE 10 :3NF ORDERS TABLE

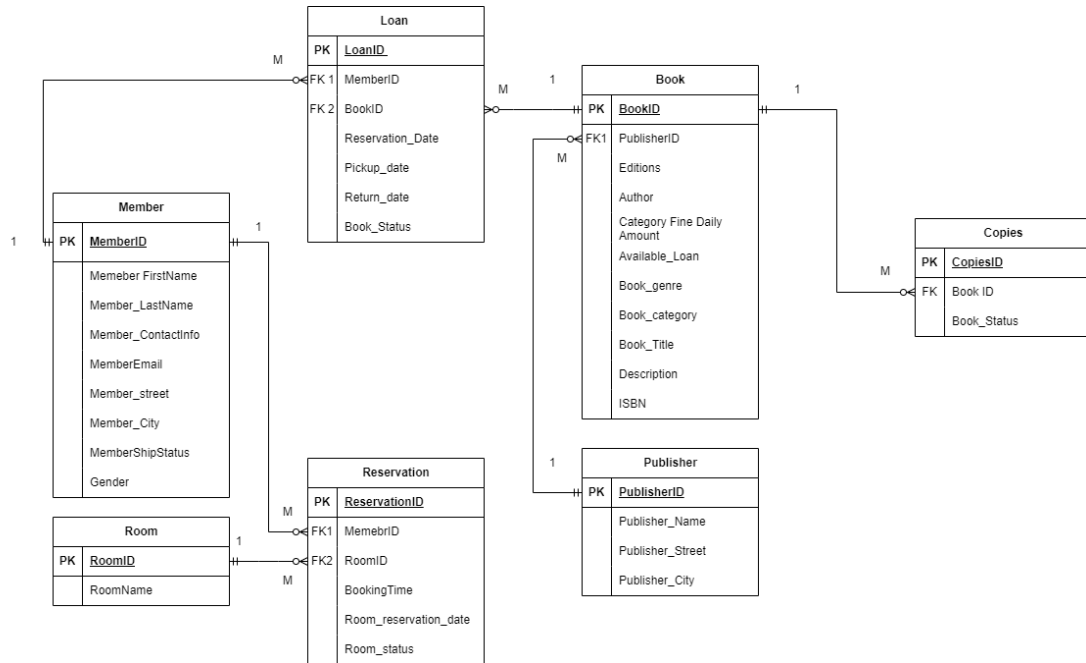
3NF ROOM'S TABLE	
Room ID PK	Room Name
Room001	Presentation Room A
Room002	Presentation Room B
Room003	Presentation Room C
Room001	Presentation Room A
Room003	Presentation Room C
Room002	Presentation Room B
Room001	Presentation Room A

TABLE 11 :3NF ROOMS TABLE

3NF RESERVATION'S TABLE					
ReservationID PK	Member ID FK	Room ID FK	Booking Time	Room reservation date	Room-Status
Record001	M001	Room001	2024.05.11. 22:30:00	2024.05.11	Cancel
Record002	M002	Room002	2024.05.11. 22:33:00	2024.05.11	Booking
Record003	M003	Room003	2024.05.12. 08:20:00	2024.05.12	Booking
Record004	M004	Room001	2024.05.13 12:20:00	2024.05.13	Booking
Record005	M005	Room003	2024.05.14 15:20:00	2024.05.14	Booking
Record006	M006	Room002	2024.05.15 21:50:00	2024.05.15	Booking
Record007	M007	Room001	2024.05.16 08:20:00	2024.05.16	Booking

TABLE 12 :3NF RESERVATIONS TABLE

4 Entity Relationship Diagram.



5 Work Matrix.

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Part	Component	Student 1 Name: Anas Wadah Mohammed qaid	Student 2 Name: Basem Ghasan Mansoor	Student 3 Name: Colin Hii Zhi Xiang	Student 4 Name: Ahmed AbdulAziz Omar Bafлах	Total
1	a) Database and Database Management System	50%	50%			100%
1	b) Business Rules & Normalization	25%	25%	25%	25%	100%
1	c) Entity Relationship Diagram			50%	50%	100%

6 References.

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