

**GROUP ASSIGNMENT (PART1).**

**TECHNOLOGY PARK MALAYSIA.**

**CT042-3-1-IDB.**

**INTRODUCTION TO DATABASE.**

**APD1F2209CS(CYB).**

**HAND-OUT DATE: WEEK 3.**

**HAND-IN DATE: WEEK 10.**

**WEIGHTAGE: 40%.**

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# **Introduction.**

DBMS usage is rising in popularity across a range of sectors, including banking, healthcare, education, and retail, among others. For organizing and modifying massive amounts of data, it is a key tool. Organizations can improve overall productivity, decrease errors, and streamline data management procedures with DBMS. A program known as a database management system, or DBMS for short, is used to quickly create, delete, or update databases, which are frequently developed by engineers or web developers. When building a database for a specific business or organization, developers typically use programs like MySQL, Oracle, or SQL Management Studio. The fact that a DBMS offers a wide range of functionality means that it is frequently used for both business and personal needs. Additionally, DBMS permits real-time data access, enabling businesses to act swiftly on information. The advantages of employing a database and DBMS, such as data consistency, integrity, and security, as well as the drawbacks of file-based systems, will all be covered in this essay. We'll also look at DBMS features including data retrieval, data storage, and data manipulation. Finally, we will apply our discussion to a case study of an e-Library Management System in Kuala Lumpur, emphasizing how the use of a DBMS can boost the efficacy and efficiency of library management. Through this examination, we can better understand the significance of DBMS in contemporary data management and the part it plays in promoting organizational expansion and development.

# **Database and Database Management System.**

## **The advantages of Database and DBMS.**

* Better Security: Access control is one of the built-in security measures that DBMS offers to make sure that only authorized users may access the data. In addition, DBMS offers security features like access control and encryption to safeguard delicate data, such member information.‎ (Benefits of Database Management Systems (DBMS) | ZoomInfo, 2023).
* Improved Data Integrity and organization: By guaranteeing that the data is accurate and consistent across all connected tables, DBMS enforces data integrity. This eliminates data duplication, which can result in errors and inconsistencies, A DBMS structures data to make it easier for libraries to manage and retrieve information like author, title, genre, and category of books. (Benefits of Database Management Systems (DBMS) | ZoomInfo, 2023).
* Consistent and trustworthy data: A DBMS makes sure that the data in the library is consistent, accurate, and up to date. Data inconsistency occurs when matching data is located in various places throughout an organization. Information about the quantity of copies of books in the library or on loan can easily be updated by librarians. (Benefits of Database Management Systems (DBMS) | ZoomInfo, 2023).
* A rise in productivity: With a DBMS, librarians can quickly retrieve information on books that members want to borrow, such as availability, loan periods, and fines for overdue books, which increases productivity because reliable DBMSs enable people to concentrate more on high-priority tasks and strategic projects. ‎ (Benefits of Database Management Systems (DBMS) | ZoomInfo, 2023).

## **The functions of DBMS.**

* A DBMS has the function of efficient and effective data storage management built in. When creating a database, sometimes the data stored inside it maybe complex and difficult to be manually organized by the developer due its complicated and scrambled nature. DBMS will be able to implement data procedural rules and validation rules for re-organizing the data inside the database. This will allow the developer or engineer to be well-organized with several types of data and easily update or delete any data in the database to be kept up to date. For instance, DBMS can help the librarian to easily organize 20,000 books from different categories and easily keep track of which books are out on loan to members of the library at any given time so that another member can rent the other books which are still available to prevent misunderstandings and unwanted errors.
* Another useful function of DBMS is the built in backup and recovery management system. A DBMS will be able to ensure the integrity and safety of the data inside it. When the system crashes and fails or there is a glitch, the backup and recovery system will kick in to ensure a copy of the previous data is saved so that the developer doesn’t need to redo everything from scratch. For example, with the amount of data of approximately 20,000 books to be stored within the database, the database requires constant maintenance to prevent hardware and software component worn outs. In the event of a glitch where the lack of maintenance is at fault, the data of the books inside the database would be backed up automatically by the DBMS as a failsafe precaution. This is especially useful when keeping records of payments of the fines for overdue books which are already paid for so to prevent the problem of multiple transactions made by the same member repeatedly.
* DBMS also has a function known as data transformation and presentation management function. This function transfers the data in the DBMS into the required data structures so that the developer, in this case the librarian, is not required to enter the data one by one and keeping the data standardized so it is easier for other librarians to understand the data inside the DBMS. For example, every book inside the library is differentiated by its own International Standard Book Number (ISBN) given based on the title of the book, the author, and the publisher. The DBMS can use the data transformation and presentation function to uniquely identify the books despite having the same author or published by the same publisher.
* Lastly, the DBMS has a data dictionary management function built in. This function is to organize the data stored inside the DBMS based on the data elements and the relationship with the metadata related to the data in a data dictionary. With this function, a repetition of data or data redundancy would also be highly reduced. For example, books such as reference books, journals, and student projects which are stored inside the library’s DBMS will be flagged and are not allowed to be borrowed or loaned by other members of the library. The books in the library are organized based on a color code. This color code of the different books will be keyed into the DBMS and stored in the data dictionary function to help the librarian differentiate the loan periods of each book based on the color code.
* Concisely, DBMS is an especially useful tool to use when handling huge amounts of data such as in a library with approximately 20,000 books to be sorted. This is to increase efficiency and effectiveness when finding a book in the library. DBMS also provides the developers with a clear and complete view of the data shared within the organization.

## **The disadvantages of file-based systems.**

There are several drawbacks to the file-based approach that might make it difficult to manage a sizable database, such as the E-Library Management approach covered in the case study. The following are a few disadvantages of the file-based system:

* Data redundancy, where data is copied and kept in many files, causes inconsistencies and errors, and is one of these disadvantages. It may be difficult to manage thousands of books and members because of this redundancy.
* Inconsistent data is yet a further disadvantage. Due to the fact that the same data is saved in numerous files, changes made in one file might not be mirrored in others, resulting in data discrepancies.
* Lack of security: Access controls and robust encryption are not available in file-based systems. They become open to security risks such as data theft, unauthorized access, and others as a result.
* Limited query capabilities: It is challenging to find and retrieve data effectively while using file-based systems since they do not offer complex query capabilities. As a result, businesses could find it difficult to make data-driven choices.
* High maintenance costs: File-based systems need manual maintenance, such as data backup, file clean-up, and permission management. This can be expensive and time-consuming, especially in big organizations.
* Limited scalability: File-based systems are not easily expandable or modifiable, making them only moderately scalable. It might be time-consuming and difficult to add new data or modify the structure of already existing data.
* Furthermore, file-based systems have a restricted capacity for data sharing. Because each application has its own collection of files and data formats, sharing data between several applications or systems can be difficult. This constraint may make it difficult for the library system to handle and share data effectively.

# **Business Rules and Normalization.**

## **Business Rules.**

* Everyone can only register one member.
* All Members with 'Active' Membership Status are Eligible to Access the Services and Benefits Provided by the Business.
* A reservation can have only one reservation status at a time.
* A Member can make multiple reservations.
* A reservation with the Reservation Status of 'Pending' indicates that the book is not yet available for checkout.
* A reservation with the status "Available" denotes that the book is available for checkout.
* Each copy of a book is unique.
* The number of copies of a book that are available is tracked.
* The Available attribute should not be less than 0."
* The Available attribute must be updated when copies are borrowed or returned.
* The Available attribute represents the number of copies that can be borrowed.
* A loan should always be connected to a particular member and a particular copy of a book.
* A loan must have a Loan Date and Return Date indicating the dates on which the book was borrowed and when it should be returned.
* If the book is returned late, a Fine Amount (in RM) will be assessed to the loan.

## **Normalization.**

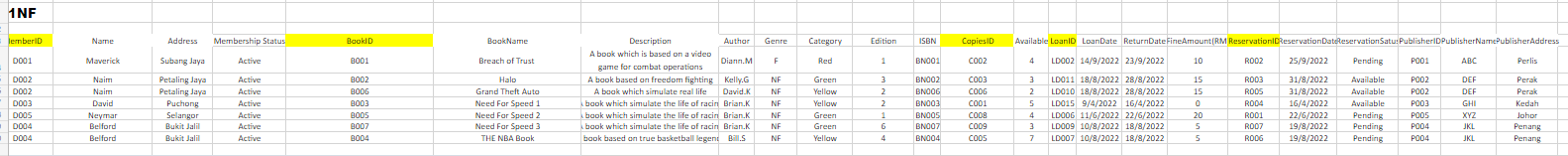
3.2.1 Unnormalized Form (UNF).

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Explanation of UNF:

The above-mentioned table refers to the unnormalized form of the database schema. The table combines all the attributes which are related to different entities together into a single table. This includes the information on member details, book details, copy details, loan details and reservation details in the database. This form does not meet any conditions of the database normalization defined by the relational model.

3.2.2 First Normal Form (1NF).



Explanation of 1NF:

The above-mentioned table refers to the First Normal Form (1NF) in the database normalization. 1NF is a property of relation in a relational database. Each attribute in the table does not consist of any repeating groups which means it does not violate the conditions of the database schema. In the Member table, it contains attributes related to the Member entity which includes Member ID, Name, Address, and Membership Status. In the Book table, it contains attributes related to the Book entity which includes Book ID, Book Name, Author, Genre, Category, Edition, Description, ISBN, Publisher ID, Publisher Name, and Publisher Address. In the Reservation table, it contains attributes related to the Reservation entity which includes Reservation ID, Member ID, Book ID, Reservation Date and Reservation Status.

In the Copies table, it contains attributes related to the Copies entity which includes Copies ID, Book ID, and Availability. Finally, in the Loan table, it contains attributes related to the Loan entity which includes Loan ID, Member ID, Copies ID, Loan Date, Return Date, and Fine Amount.

**Partial dependencies:**

LoanID = MemberID, CopiesID, LoanData, ReturnData, FineAmount(RM)

CopiesID = BookID, Available

ReservationID = MemberID, BookID, reservstionData, Reservation Status

BoodID = BookName, Author, Genre, Category, Edition, Description, ISBN,

PublisherID, PublisherName, PublisherAddress

MemberID = Name, Address, Membership Status

**Transitive Dependencies:**

ISBN = Author, Edition

PublisherID = PublisherName, PublisherAddress

3.2.3 Second Normal Form (2NF).

Explanation of 2NF:

In the realm of database normalization, 2NF (or Second Normal Form) is a technique that many experts employ to eliminate redundant and dependent data. As an expansion of the fundamental concepts outlined in First Normal Form (1NF), this strategy aims to streamline relational databases. We reduce the dependence and resolve the partial dependencies during this phase. We have five primary keys (MemberID, BookID, ReservationID, LoanID, and CopiesID) and five external keys (MemberID and BookID in the reservation table) to identify which book was reserved by whom. The Copies table has one foreign key, BookID, to inform libraries of the number of copies of a particular book. MemberID and CopiesID are foreign keys in the loan table that identify who desires the book and whether or not it is available for loan. ‎

1. MemberID->Name, Address, MemberShipStatus.
2. ReservationID-> MemberID, BookID, ReservationDate, ReservationStatus.
3. CopiesID-> BookID, Available.
4. LoanID-> MemberID, CopiesID, LoanDate, ReturnDate, FineAmount(RM).
5. BookID-> bookName, Genre, Category, Description, ISBN, PublisherID, Author, Edition, PublisherName, PublisherAddress.

*Member:*

|  |  |  |  |
| --- | --- | --- | --- |
| MemberID | Name | Address | MemberShipStatus |
| D001 | Maverick | Subang Jaya | Active |
| D002 | Naim | Petaling Jaya | Active |
| D003 | David | Puchong | Active |
| D004 | Belford | Bukit Jalil | Active |
| D005 | Neymar | Selangor | Active |

*Reservation:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ReservationID | MemberID | BookID | ReservationDate | ReservationStatus |
| R001 | D005 | B005 | 22/6/2022 | Pending |
| R002 | D001 | B001 | 25/9/2022 | Pending |
| R003 | D002 | B002 | 31/8/2022 | Available |
| R004 | D003 | B003 | 16/4/2002 | Available |
| R005 | D002 | B006 | 31/8/2022 | Available |
| R006 | D004 | B004 | 19/8/2022 | Pending |
| R007 | D004 | B007 | 19/8/2022 | Pending |

*Copies:*

|  |  |  |
| --- | --- | --- |
| CopiesID | BookID | Available |
| C001 | B003 | 5 |
| C002 | B001 | 4 |
| C003 | B002 | 3 |
| C005 | B004 | 7 |
| C006 | B006 | 2 |
| C008 | B005 | 4 |
| C009 | B007 | 3 |

*Loan:*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LoanID | MemberID | CopiesID | LoanDate | ReturnDate | FineAmount(RM) |
| 2 | 1 | 2 | 14/9/2022 | 23/9/2022 | 10 |
| 6 | 5 | 8 | 11/6/2022 | 22/6/2022 | 20 |
| 7 | 4 | 5 | 10/8/2022 | 18/8/2022 | 5 |
| 9 | 4 | 9 | 10/8/2022 | 18/8/2022 | 5 |
| 10 | 2 | 6 | 18/8/2022 | 28/8/2022 | 15 |
| 11 | 2 | 3 | 18/8/2022 | 28/8/2022 | 15 |
| 15 | 3 | 1 | 9/4/2022 | 16/4/2022 | 0 |

*Book:*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| BookID | BookName | Author | Genre | Category | Edition | Description | ISBN | PublisherID | PublisherName | PublisherAddress |
| B001 | Reach of Trust | Diann.M | NF | Red | 1 | A book which is based on a video  game for combat operations | BN001 | P001 | ABC | Perlis |
| B002 | Halo | Kelly.G | NF | Green | 3 | A book based on freedom fighting | BN002 | P002 | DEF | Perak |
| B006 | Grand Theft | David.K | NF | Yellow | 2 | A book which simulates real life | BN006 | P002 | DEF | Perak |
| B003 | Need For Speed 1 | Brian.K | NF | Yellow | 2 | A book which simulates the life of racing | BN003 | P003 | GHI | Kedah |
| B004 | THE NBA book | Bill.S | NF | Yellow | 4 | A book based on true basketball legends | BN004 | P004 | JKL | Penang |
| B007 | Need For Speed 3 | Brian.K | NF | Green | 6 | A book which simulates the life of racing | BN007 | P004 | JKL | Penang |
| B005 | Need For Speed 2 | Brian.K | NF | Green | 1 | A book which simulates the life of racing | BN005 | P005 | XYZ | Johor |

3.2.4 Third Normal Form (3NF).

Explanation of 3NF:

The aforementioned tables are the result of 3NF, which stands for third normal form, and the primary goal of the step is to reduce redundancy and make the data easier to manipulate and flow through by solving the transitive dependencies. It is evident from the BOOK table that two columns (PublisherID and ISBN) are foreign keys, and with these keys, each key has its own table, which is identified by the Primary key. The attributes will be duplicated twice (BOOK, their primary table). At the conclusion of this phase, it appears that there are seven tables containing distinct entities.

1. MemberID->Name, Address, MemberShipStatus.
2. ReservationID-> MemberID, BookID, ReservationDate, ReservationStatus.
3. CopiesID-> BookID, Available.
4. LoanID-> MemberID, CopiesID, LoanDate, ReturnDate, FineAmount(RM).
5. BookID-> bookName, Genre, Category, Description, ISBN, PublisherID.
6. ISBN-> Author, Edition.
7. PublisherID->PublisherName, PublisherAddress.

*Member:*

|  |  |  |  |
| --- | --- | --- | --- |
| MemberID | Name | Address | MemberShipStatus |
| D001 | Maverick | Subang Jaya | Active |
| D002 | Naim | Petaling Jaya | Active |
| D003 | David | Puchong | Active |
| D004 | Belford | Bukit Jalil | Active |
| D005 | Neymar | Selangor | Active |

*Reservation:*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ReservationID | MemberID | BookID | ReservationDate | ReservationStatus |
| R001 | D005 | B005 | 22/6/2022 | Pending |
| R002 | D001 | B001 | 25/9/2022 | Pending |
| R003 | D002 | B002 | 31/8/2022 | Available |
| R004 | D003 | B003 | 16/4/2002 | Available |
| R005 | D002 | B006 | 31/8/2022 | Available |
| R006 | D004 | B004 | 19/8/2022 | Pending |
| R007 | D004 | B007 | 19/8/2022 | Pending |

*Book:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| BookID | BookName | Genre | Category | Description | ISBN | PublisherID |
| B001 | Reach of Trust | NF | Red | A book which is based on a video  game for combat operations | BN001 | P001 |
| B002 | Halo | NF | Green | A book based on freedom fighting | BN002 | P002 |
| B006 | Grand Theft | NF | Yellow | A book which simulates real life | BN006 | P002 |
| B003 | Need For Speed 1 | NF | Yellow | A book which simulates the life of racing | BN003 | P003 |
| B004 | THE NBA book | NF | Yellow | A book based on true basketball legends | BN004 | P004 |
| B007 | Need For Speed 3 | NF | Green | A book which simulates the life of racing | BN007 | P004 |
| B005 | Need For Speed 2 | NF | Green | A book which simulates the life of racing | BN005 | P005 |

*Copies:*

|  |  |  |
| --- | --- | --- |
| CopiesID | BookID | Available |
| C001 | B003 | 5 |
| C002 | B001 | 4 |
| C003 | B002 | 3 |
| C005 | B004 | 7 |
| C006 | B006 | 2 |
| C008 | B005 | 4 |
| C009 | B007 | 3 |

*Loan:*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LoanID | MemberID | CopiesID | LoanDate | ReturnDate | FineAmount(RM) |
| 2 | 1 | 2 | 14/9/2022 | 23/9/2022 | 10 |
| 6 | 5 | 8 | 11/6/2022 | 22/6/2022 | 20 |
| 7 | 4 | 5 | 10/8/2022 | 18/8/2022 | 5 |
| 9 | 4 | 9 | 10/8/2022 | 18/8/2022 | 5 |
| 10 | 2 | 6 | 18/8/2022 | 28/8/2022 | 15 |
| 11 | 2 | 3 | 18/8/2022 | 28/8/2022 | 15 |
| 15 | 3 | 1 | 9/4/2022 | 16/4/2022 | 0 |

*ISBN:*

|  |  |  |
| --- | --- | --- |
| ISBN | Author | Edition |
| BN001 | DiAnn.M | 1 |
| BN002 | Kelly.G | 3 |
| BN003 | Brian.K | 2 |
| BN004 | Bill.S | 4 |
| BN005 | Brian.K | 1 |
| BN006 | David.K | 2 |
| BN007 | Brian.K | 6 |

*Publisher:*

|  |  |  |
| --- | --- | --- |
| PublisherID | PublisherName | PublisherAddress |
| P001 | ABC | Perlis |
| P002 | DEF | Perak |
| P002 | DEF | Perak |
| P003 | GHI | Kedah |
| P004 | JKL | Penang |
| P004 | JKL | Penang |
| P005 | XYZ | Johor |

# **Entity Relationship Diagram.**

A picture containing text, diagram, parallel, line

Description automatically generated

**Explanation for Entity Relationship Diagram:**

The above-mentioned table shows the Entity Relationship Diagram where all the attributes and entities are related and connected with their own respective relationships. The Member table has a one-to-many relationship with the Loan table and a one-to-many relationship with the Reservation table. Likewise, the Loan table has a many-to-one relationship with the Member table. The Reservation table has a many-to-one relationship with the Member table.

The Loan table has a many-to-one relationship with the Copies table and a many-to-one relationship with the Book table. The Reservation table has a many-to-one relationship with the Book table. Next, the Book table has a one-to-many relationship with the Copies table. The Book table has a many-to-one relationship with the Publisher table. Lastly, the Book table has a one-to-one relationship with the ISBN table and the ISBN table has a one-to-one relationship with the Book table.

The above relationships between each entity consists of only one-to-one relationships and one-to-many relationships where each table connection has a connectivity and cardinality between each of them.

# **Work Matrix.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Part** | **Component** | **Naim Nasruddin bin Nazri** | **Terence Ling Chee Yew** | **Ooi Hong Ping** | **ABDULRAHMAN GAMIL MOHAMMED AHMED** | **Total** |
| **1** | 1. Database and Database Management System | **25%** | **25%** | **25%** | **25%** | **100%** |
| **1** | 1. Business Rules & Normalization | **25%** | **25%** | **25%** | **25%** | **100%** |
| **1** | 1. Entity Relationship Diagram | **25%** | **25%** | **25%** | **25%** | **100%** |

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