NPI000150-NPI000140-NPI000141-NPI000178-DBMS GROUP COMPONENT-1

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Introduction

As per the request from UPA University, this system was made. This system's main purpose is to design a database model, implement that model according to the requirement and document the database system for UPA University Library Management system. The old system was a file-based system so it was necessary to use this system to solve the various business problems. This system was successfully created with a lot of group effort and research. This system consists of documentation of research of different fields in respective manner: Business rules required in library, listing required entity and attributes as well the relations between entities, this ER diagram followed by normalization and finalized ERD (Entity Relationship Diagram) diagram. Finally, database schema as well as different tables were created using MySQL.

Acknowledgement

For providing us this grand opportunity of implementing the knowledge learned from class into a small project, our group would like to give our sincere respect to APU family, Infomax family as well as our subject teacher Ms. Isha Baral. The completion of our project was only possible due to the terrific way of teaching, proper guidelines for project-related ideas and giving meaningful theory with a notable example from Ms. Isha Baral.

1.0 File based management system

File-based system is a technique used by the system to data in a medium. By using this we do not have to follow old methods of writing and managing paper and documents.
Although File based system have many drawbacks.

1.1 Disadvantages of File-based Management system:

1. **Accessibility**: Although file-based systems are made more reliable than the traditional way it can be easily accessed by anyone anywhere. Due to being easily accessible it is hard to secure the data. Like if we keep important information about the library and form file base system it insecure and anyone can access the data that we have kept.

2. **Data duplication**: There is always a high chance of duplication. Due to data that can be stored in more than 1 place. It causes duplication and is difficult to correct. Whereas, if write one information of one person in library in one file and write another information in another file then that will cause duplication of data.

3. **Atomicity**: Those files that are either incomplete or missing are Atomicity. It causes transaction failure due to incomplete files. Furthermore, we couldn't manage to gather the information that we are searching for in library if the file is incomplete.

4. **Inconsistence**: Due to duplication located in many places that cause redundancy which led to data inconsistence. Such as if we store the information in multiple place then we may not find the data when it required.

5. **Security problem**: Anyone can access file-based system easily. To avoid security problems only authorized and limited people should be allowed to access the database. As there is no any security item to secure the data in library people can easily access the data without any hesitation even though if people are not access to the system.

6. **Limited data sharing**: Due to diverse types and formats of files and data. It is hard to share between different departments and limited in nature. As proof, in library while using file based system we keep data in different place within a different format but while sharing data within a group of people it is hard to collect all the required information for the source.

2.0 Database and DBMS (Database management system):

Database is the set of data and information which is stored in various server -type data storage. All Database have multiple table which contain many related and several different fields. We can take a company database which may include tables for products, financial records, employees, etc. as an example of Database.

Database management systems are the collection of programs or software which enables the user to make, maintain as well as use of Database.

2.1 Advantage of Database and database management system

1. **Reduce Data redundancy**: The record-based information management framework contained many records located in many different areas, either within one framework or even between different frameworks. This could result in different duplicates of the same dataset, resulting in repeated information. This is a single database and any changes will be reflected immediately, so it is expected in the database. Therefore, there is no way to learn how to copy information. For example, if we keep the data of library in multiple place and at the time of changing data then we can easily access the data and change the data.

2. **Data sharing**: Databases permit database clients to share information between themselves. Like it gives the people of library to create variety of information from data they have taken and also permit distributing the data among themselves who have access to the system of library.

3. **Privacy**: It secure the data and make privacy in the particular field by not allowing the other user to access the database. Only the accessible person have right to access the database and access the information. In library, only the librarian have right to access the data that is relate to their sector.

4. **Backup and recovery**: It help to recover the existing data which was available in past. Furthermore, it help to secure the data for future use. Whereas, in library we can collect the information of the person what they are reading and what type of book category member is using.

5. **Data consistency**: It refers to, if the data of same place or different match or not to its defining data type. For example, the name of books must be in character and its price must be in integer.

6. **Data Integrity**: Information astuteness implies that the information is precise and reliable within the database. Information Judgment is exceptionally imperative as there are different

databases in a DBMS. All these databases contain information that is obvious to different clients. So, it is vital to guarantee that the information is correct and steady in all the databases and for all the clients.

2.2 DATABASE MANAGEMENT SYSTEM FUNCTION:-

1   **Data storage management**: It creates meaningful set of structure required for the purpose of storing the data in complicated way. It decreases the workload of user for deferent physical aspect of data storing process.

1. **Security and management**: DBMS is more secure. It helps in Data security and its privacy with management facility.

2. **Data dictionary management**: It stores the data entity and their relationship. Those types of data are known as metadata. Metadata include data type's relation between data integrity constraints. DBMS do data abstract and remove data dependency.

3. **Backup and recovery**: In case of data lose DBMS provides utilities which allow DIM which check daily routine and special backups and do restores.

4. **Multiuse access control**: At the same time it allows group of user to access the data base without delaying or any type of data error. Therefore it ensure data constancy and integrity.

5. **Management of data integrity**: The DBMS recommends and encourage the different rules for maximizing integrity and decreasing data redundant.

6. **Data transform and Presentation**: DBMS always supports data that are independent. DBMS logically requests with the help of commands that are physically located and retrieve those data.

7. **Database communication interface**: With the help of the network anyone can access the database. It is easier while doing communication between user's points.

2.3 Relation with case study

As the UPA library was based on file-based management system, the problems in the management was increasing day by day. With the drawbacks of file-based system, it was impossible to manage the data for which purpose with was stored. So, the DBMS was the comparatively better choice. As DBMS can easily manage the data which was required to search the various data of library such as details of book, author, publisher as well as members. It also solve the problem of data security. It is easy to use and doesn't required as many human resources as managing the data in file-based management system. It is also easy to update the data in DBMS. So, the DBMS is ultimately better choice for the UPA library than that of manually functioning File-based management system.

3.0 Business rules and Normalization:

3.1 Business Rules

Before we explain about the business rules of library, we must specify the meaning of business rules. Business rule is the rule which should be followed in the business to run the business properly without any hindrance. Setting realistic business plan, observing the primary competition, working as a team, and getting professional assistance for the future are some of the most important business rules for success etc.

The following are the business rules of the library, that our members are required to follow –
- In the library, there should be absolute silence.
- After reading, the members are required to place the book exactly where they found it.
- There is no limit on the number of books a person can borrow.
- Borrowers are limited to a maximum of five books at a time.
- In the library, smoking, eating, and sleeping are absolutely prohibited.
- In the library, cell phones must be muted or set to vibrate. In the event of an emergency or an incoming call, the receiver or the caller must be taken outside the library.
- Students and others can join our library organization by sending an application to our email address, visiting the library to register in person, or by signing up and filling out your personal details on our website.
- You can reserve a book for the future by adding it to your reading list or by telling the librarian about the book you want to reserve, and we will reserve it for you. If the book you want is not available at the time you want it, we will try to locate another copy and let you know when it becomes available.
- While returning a book, our members must be on time, and when borrowing a book from the library, they must indicate a date for when they will return the book. Our library allows a two-day grace period after the due date; if the book is not returned by the grace period's conclusion, our members will be charged unless a compelling cause for the delay is supplied.

3.2 Normalization

Normalization is the process of creating table without data redundant to make data efficient. Splitting tables into multiple ones and re-joined or linked each are involved in normalization.

According to the case of UPA library, table below is the prime example for UNF condition:-

Student Name	Student_ID	Department	Department_ID	Teacher	T.phone
Ram	NP001	CSIT	DP010	Tika	9803214565
Sita	NP002	Education	DP045	Sona	9866754623, 9874561230
Gita	NP004	Engineering	DP018	Deepak	9847678923
Hari	NP003	Economics	DP007	Mina	9806154321, 9876543210

Table 1: Un Normal Form (UNF)

From the above table we see multiple data in same row which can be known as un normalized form of table. So that, it causes data redundancy. To overcome those cause it should be further normalized.

3.3 First Normal Form (1NF)

There are some criteria to follow to perform the first normal form, some of them are as follows:
 - ➢ Rows should not be duplicated in the table.
 - ➢ There should be single values in each shell.
 - ➢ Group should not be repeated.

So by applying the rule of 1NF, we can illustrate the above UNF (un normal form) table into 1NF (first normal form) as below:

Student Name	Student_ID	Department	Department_ID	Teacher	T.phone
Ram	NP001	CSIT	DP010	Tika	9803214565
Sita	NP002	Education	DP045	Sona	9866754623
Sita	NP002	Education	DP045	Sona	9874561230
Gita	NP004	Engineering	DP018	Deepak	9847678923
Hari	NP003	Economics	DP007	Mina	9806154321
Hari	NP003	Economics	DP007	Mina	9876543210

Table 2: First Normal Form (1NF)

The above table has been created after applying the first normal form rule. As, we can see that the data of each row are atomic and same kind of data in each attribute. In the above table, there are two student_id with same id so we need to consider both student_id and book to identify diversely.

3.4 Second Normal form (2NF)

The requirement for the second normal form are as follows:-
- ➢ Firstly, the table need to be in 1NF.
- ➢ Partial dependency should not be on the table.

Partial dependency: The dependency of non-primary key functionally on portion of single or collection of a unique key is known as partial dependency.

Student Name	Student_ID	Department	Department_ID	Teacher	T.phone
Ram	NP001	CSIT	DP010	Tika	9803214565
Sita	NP002	Education	DP045	Sona	9866754623
Sita	NP002	Education	DP045	Sona	9874561230
Gita	NP004	Engineering	DP018	Deepak	9847678923
Hari	NP003	Economics	DP007	Mina	9806154321
Hari	NP003	Economics	DP007	Mina	9876543210

Table 3.1

As we can see from the above table 3.1 which is in 1NF and to convert it into 2NF we have meet the some 2NF requirement. There is partial dependency in the above table between the non-key attributes and candidate key. In which Student_ID and department, teacher, teacher phone are partial connected with the Student_ID through Department_ID.

Conversion into 2NF

Department	Department_ID	Teacher	T.phone
CSIT	DP010	Tika	9803214565
Education	DP045	Sona	9866754623
Education	DP045	Sona	9874561230
Engineering	DP018	Deepak	9847678923
Economics	DP007	Mina	9806154321
Economics	DP007	Mina	9876543210

Table 3.2: Department information table

Student Name	Student_ID
Ram	NP001
Sita	NP002
Hari	NP003
Gita	NP004

Table 3.3: student information table

Student_ID	Department_ID
NP001	DP010
NP002	DP045
NP003	DP018
NP004	DP007

Table 3.4

3.5 Third normal form (3NF)

The following properties should be followed to form a Third normal form of table:

- ➢ The rule of second normal form should meet by the table.
- ➢ Transitive dependencies should not exist.
- ➢ All the non-primary keys must be mutually independent.

Transitive dependency:- The dependency of two non-primary attribute on each other is known as transitive dependency.

Department	Department_ID	Teacher	T.phone
CSIT	DP010	Tika	9803214565
Education	DP045	Sona	9866754623
Education	DP045	Sona	9874561230
Engineering	DP018	Deepak	9847678923
Economics	DP007	Mina	9806154321
Economics	DP007	Mina	9876543210

Table 4.1

There is a transitive dependency between Department_ID and T.phone. The T.phone depends on the Department_ID. If you change the Department_ID, T.phone may also change. Therefore, the table has transitive dependencies that do not meet the third normal form condition.

Conversion into 3NF

Department	Department_ID	Teacher
CSIT	DP010	Tika
Education	DP045	Sona
Engineering	DP018	Deepak
Economics	DP007	Mina

Table 4.2

Teacher	T.phone
Tika	9803214565
Sona	9866754623
Deepak	9847678923
Mina	9806154321

Table 4.3

Student Name	Student_ID
Ram	NP001
Sita	NP002
Hari	NP003
Gita	NP004

Table 4.4

Student_ID	Department_ID
NP001	DP010
NP002	DP045
NP003	DP018
NP004	DP007

Table 4.5

To overcome the transitive dependency and avoid data redundancies of the table 4.1, the table is normalized into third normal form. In which rules of third normal form has been applied, the table in 2NF i.e. Table 4.1 is divided and new table is formed. The new table provide information about the teacher phone number.

4.0 Entity Relationship Diagram (ERD)

The diagram that represent the relationship between the given entities is known as Entity Relationship Diagram (ERD). There are some of the step to be followed which are required to develop Entity Relationship diagram. The steps are as follow:

Step 1: Identification of entities
Step 2: Identification of attributes of given entities
Step 3: Identification of relationship between the entities.

It will be easier for making Entity Relationship diagram, if we follow those above step.
Identification of entities
Entities: The thing that have existence as contrasted with its attribute. The entities that are possible for the given scenario are as follow:
Entities
1. Book
2. Publisher
3. Author
4. Staff
5. Student
6. Member
7. Department
8. Reservation
9. Category
10. Bills
11. reports

Description of each entity:

Entities	description
Book	Every people who come to the library will have a book in his\her list.
Category	List the item that are available on the different basics.
Publisher	Every book which will be borrowed by the each and every person have information about publisher.
Author	Book will have another information about author.
Staff	All the people who manage the library.
Member	This particular entity hold the information about people who uses books.
Department	This entity related with the student from which department they are and give information about department.
Reservation	Provide detail about no of reserve book and reservation detail.
Bills	Display method of payment and total payment of person.
Reports	Offer information about book availability.
Student	No of student who borrow book.
Book_loan	Detail of book which are currently on loan.

4.1 Identifying attributes of entities

The things that describe the characteristics of each entity is known as attribute. The attribute of the above listed entities are as follow:

Attributes:

1. Book
     I.   Book_ID
     II.   Price
     III.   Title
     IV.   Edition
     V.   ISBN
     VI.   Publisher_ID
     VII.   Author_ID
     VIII. Book_Status
     IX.   Category_ID
     X.   Subject_area
     XI.   Published-date

2. Publisher
     I.   Publisher_ID
     II.   Name
     III.   Address
     IV.   Phone
     V.   email

3. Author
     I.   Author_ID
     II.   Author_name
     III.   Author_add
     IV.   Author_phone
     V.   Email

4. Staff
     - Staff ID
     - Staff name
     - Staff address
     - Staff phone
     - Department_ID
5. Member
     - Member ID
     - Member phone
     - Member address
     - Member email

- Member name
- Staff_ID
- Student_ID
- No_of_book_borrow

6. Student
   I. Student_ID
   II. Student_name
   III. Student_address
   IV. Department_ID
   V. Phone number
   VI. Email
7. Reports
   I. Reg.no
   II. Book return_date
   III. Due_date
   IV. Issue_date
   V. Member_ID
8. Bill
   I. Bill_number
   II. Member_ID
   III. Amount
   IV. Date
   V. Fine
9. Reservation
   I. Reservation_ID
   II. Reservation_date
   III. Member_Id
   IV. Book_ID
   V. Book_status
10. Category
   I. C-ID
   II. C_name
   III. type
11. Department
   I. Department_ID
   II. Name
   III. Head
12. Book_loan
   I. Book_ID
   II. Publisher_ID
   III. Member_ID
   IV. Lend
   V. Fine

4.2 Explanation of attribute of each single entities:

Entity:- Book

Attributes	explanation
Book_ID	Unique primary number of book.
Price	Which have integer value of book.
Title	Provide information about book related name.
Edition	Have time information from book.
ISBN	International standard book number.
Author_ID	Author who has written book.
Staff_ID	Foreign key to connect staff and book.
Publisher_ID	Name of the person who publish book.
Subject_area	From which area the book is related.
C_ID	Hold category number of book.
Published_Date	Date of publish of book.

Entity: Publisher

Attributes	description
Publisher_ID	Unique primary key of the publisher.
Name	Name of the person who publish book.
Phone	It is the numeric value that provide contact detail of the publisher.
Publisher_address	String that hold the place that where the publisher is from.
Email	Electronic address to connect.

Entity: Staff

Attributes	description
Staff_ID	Unique primary key of staff.
Staff_name	Name of the person who take book and belong to staff group.
Staff_phone	Contact number of the staff.
Staff_address	Place where staff belong.
Department_ID	Id of the department in which staff belong.

Entity: member

Attributes	description
Member ID	Primary key of the member entities.
Name	Name of the member who borrow book.
Department_ID	Id of the department where member belong.
Type	Give information about member weather the member is staff or student.
No.of_book_borrow	Number of book borrowed by member of the library.

Staff _ID	Foreign key that connect staff and member.
Student_ID	Foreign key that connect student and member.
Member status	Provide information about active and inactive member.
Phone number	Detail information to contact the member.

Entity: student

Attributes	description
Student_ID	Id no of the student who borrow book form library.
Student_name	Name of the student who take book from library.
Student_phone	Contact deatail of the student.
Student_address	Place where student live.
Department_name	From which department student belongs to.
Member_ID	Member ID of the particular student.

Entity: Report

Attributes	description
Report no	Unique report no.
Issue Date	Date of reservation.
Book_status	Status of book.
Reservation_no	Information of reservation.
Member_id	ID of the person who have issue the book.

Entity: Bill

Attributes	description
Bill_num	Unique primary integer values of Bill
Bill_date	Time when the bill have taken.
Fine	Amount to be paid in library for not submitting the book in time.
Amount	Money to be paid in fine.
Member_Id	Member information who have bill.

Entity: Author

Attributes	description
Author_ID	Identification number of author.
A_Name	Name of the write of the book.
A_Add	Address of the author.
A_Phone	Contact information of the author.

Entity: Reservation

Attributes	description
Reservation_ID	Unique primary integer values of reservation.
Reservation_date	Date when the particular person have reserve book.
Member_ID	ID of the person who reserve book.
Book_ID	ID of book which have been reserve by the people.

Entity: Category

Attributes	description
C_ID	Unique primary integer values of category.
C_name	Name of the category where book belong to.
Type	Type of category book are form.

Entity: department

Attribute	description
Department_ID	Integer that give identity information about department.
Name	Name of the department member belong.
Head	Head of the articular department.

Entity: book_loan

Attribute	description
Book_ID	Book identity number.
Publisher_ID	Publisher identity number.
Member_ID	Member identity number.
Lend	Date of issue from library.
Due	Last deadline to submit book.
Return	Book return date.
fine	Amount of money that has been paid in library due to last submission.

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4.3 ER-Diagram
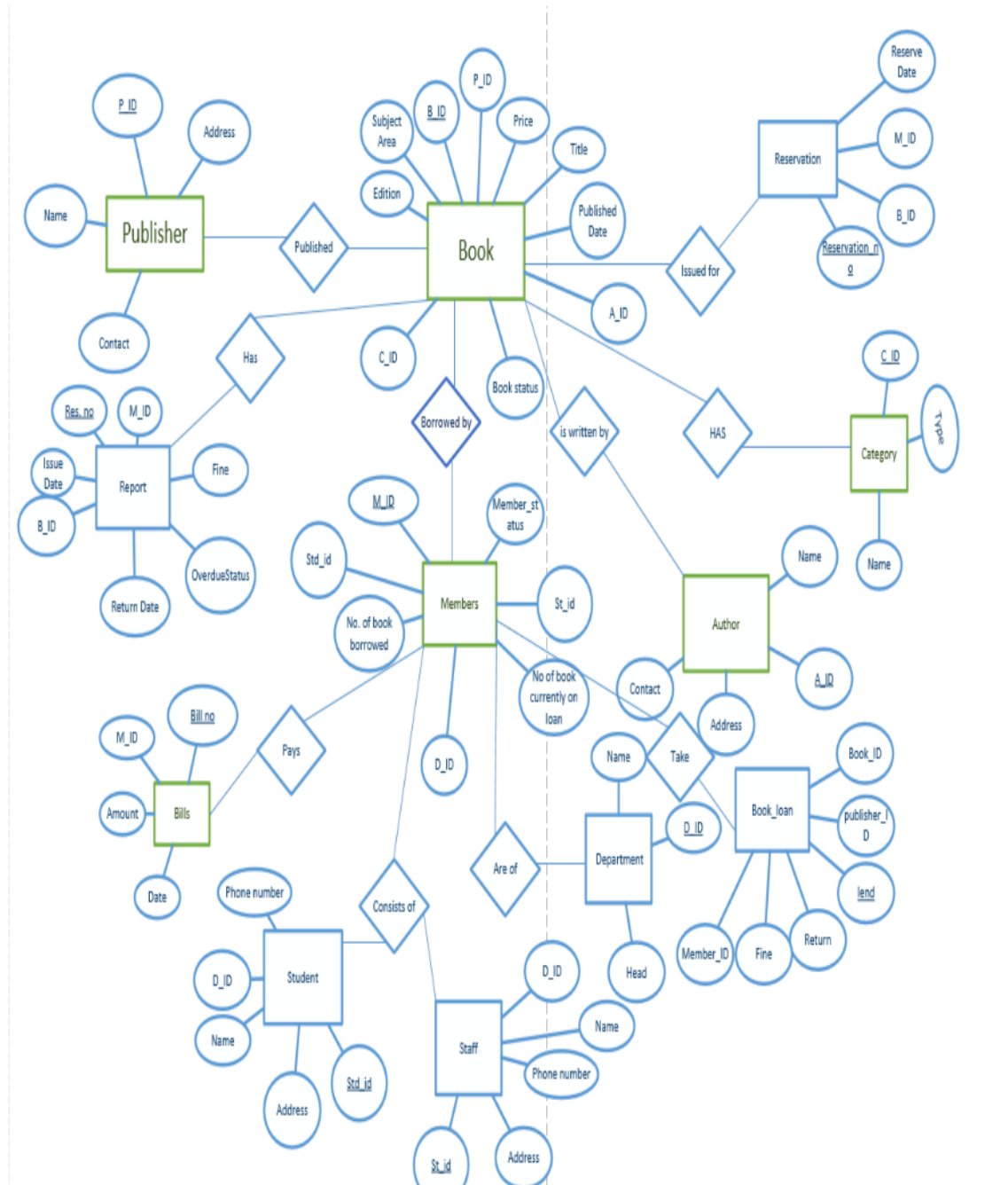
4.4 Relation between entities identification

To make ER-diagram firstly, we must find the relationship between set of two entities. This makes it easy to create an ER diagram. There are four main types of relationships that link entities, which are described below.

One to one (1:1)

One to one relation is the relation between the two entities in which one entity is linked with one and   only   one   entity.
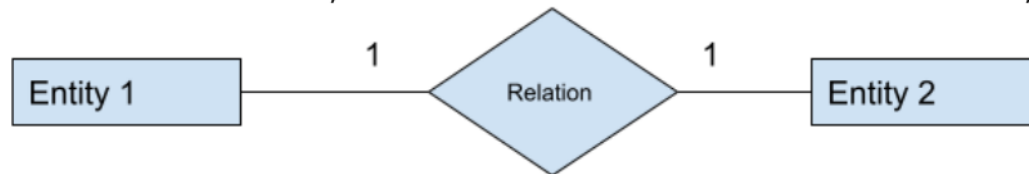

Fig: one to one relation

One to many (1:M)

It the condition of relation in which one entity is associated with the many entities set.
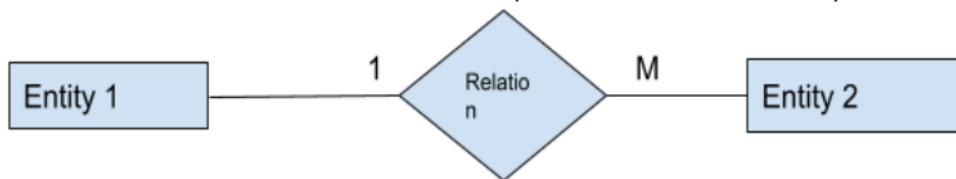
Fig: one to many relation

Many to one (M: 1)

It is the condition on the relation in which many entitles are related with one and only entities in the another.
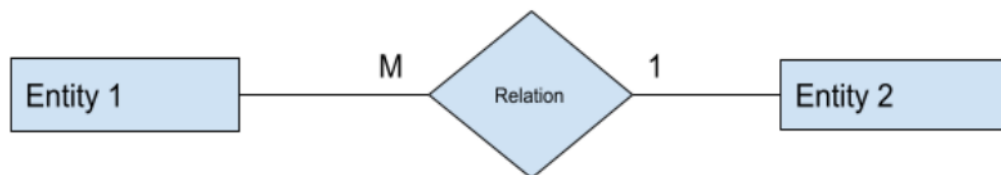

Fig: many to one relation

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Many - Many (M: M)
If number of entities are associated with one or more number of entities then this condition will be known as many-many relation.
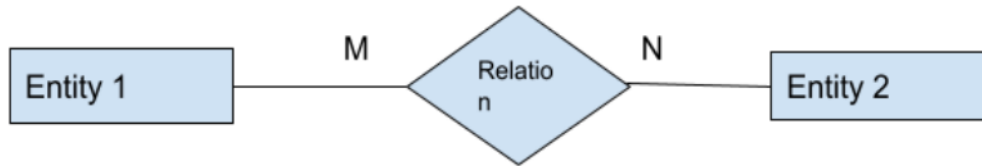

Fig: many to many relation

Relating to the above case (case of UPA library), following set of relation between entities are found:

Relation	Explanation
Publisher M:N Book	In library there are many book which are published by many publisher.
Book 1:M Author	Many book can be written by one author, we can find the many that has been written by one author.
Member 1: M Book	One member can take many book from the library.
Book M:1 Report	Report of the all the can be written in one report.
Member 1:1 Bill	One member who use library pay the one bill if he/she is paying fine.
Member M: N Department	Many department has many staff for work.
Member 1:1 Student	One member can be a one student.

5.0 Constraint

Logical constraints:
    I.   Each student and staff can has only one member id which indicates one can create only one membership card.
    II.   Members can pre book the required book if the book is currently unavailable
    III.   Category type itself defined the book in which duration of time we can loaned for.
    IV.   The member has to pay the extra price i.e. fine for delaying in return of the book.
    V.   The total no of book borrowed can defined the member as active or inactive user.

Primary key constraints:
    I.   All the primary keys are mixture of number and letters.
    II.   The characters consists of symbolic form of table name in letters followed by numbers.

Default constraints:
    I.   As the Over Due Status is positive or negative, fine is optional.
    II.   The final amount of book in bill is default as it is with the additional fine for delaying in returning.
    III.   The fine of different category type books varies.

Null constraints:
A null keyword that indicates that a column can store a null value for that data type. This means that the column does not need to receive a value during an insert or update operation. A NULL constraint is logically equivalent to omitting a NOT NULL constraint from a column definition.

Unique constraint
It makes sure that every component or values of every column is unique. Unique constraint as well as primary key makes sure to create a uniqueness for each set of column.

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