PROJECT REPORT PHASE – 2

Group Number : 23

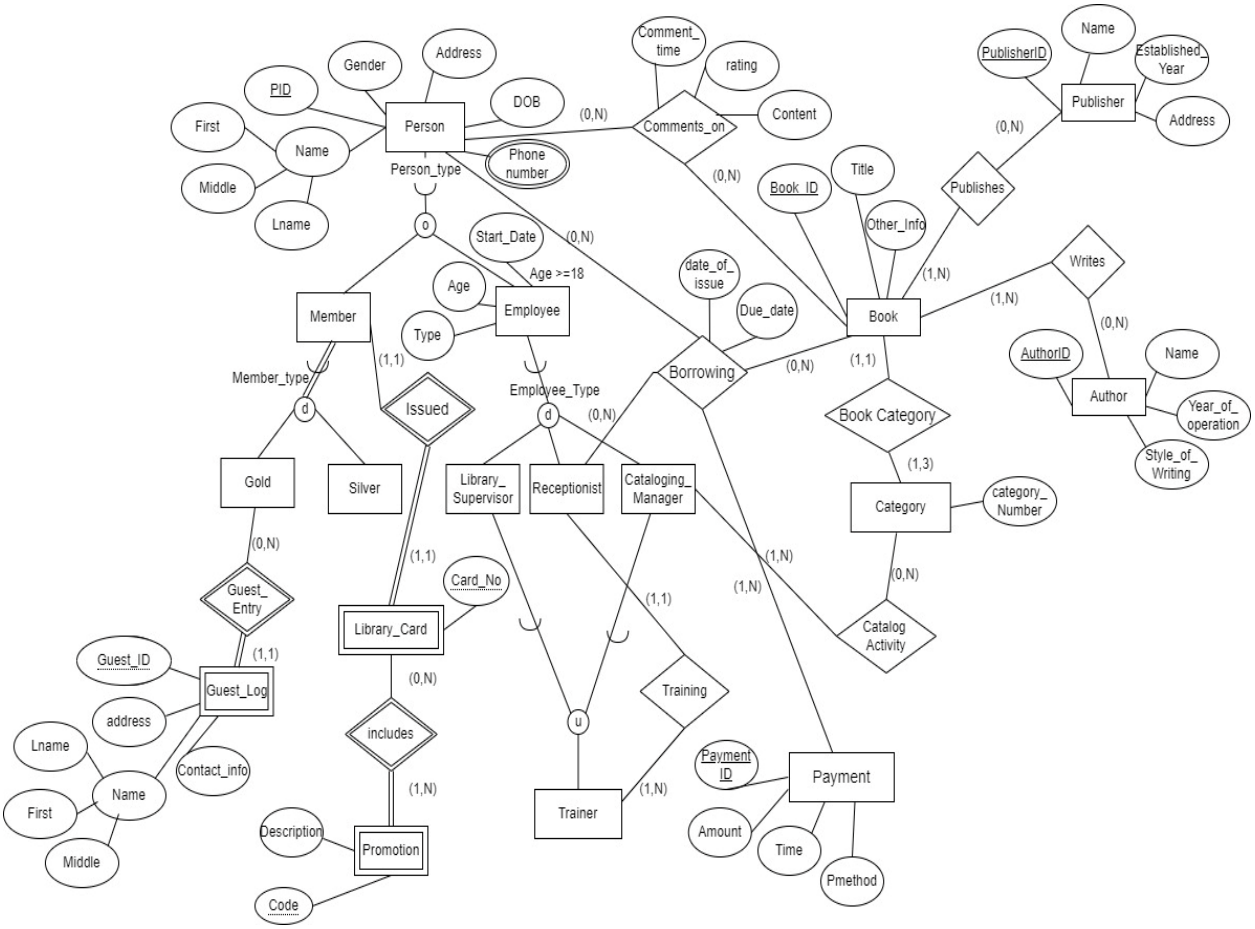
Phase II. Logical Database Design. It has been decided to use a relational DBMS to implement the database. Perform the following steps.

a. Convert your Conceptual model (Phase I, feel free to change your conceptual model if needed and draw EER after your modifications) to an implementation data model that can be implemented in a relational DBMS like Oracle. During this process you replace M-N relationships and multi-valued attributes with constructs that can be implemented in the relational DBMS.

b. Document your design in Database Schema format, explain how you obtained you schema. The output of Phase II is the schema of database derived from your EER design. Please indicate the primary keys and foreign keys of each relation.

Solution :

The modified EER diagram is as below :



EER To Relational Mapping

Step 1 ,8 and 9 : Mapping of Regular Entity , Specialization/ Generalization and Union type

CATEGORY is a strong entity with 'Category_Number' as the primary key.

PAYMENT is a strong entity with primary key as 'Payment_ID'.

PUBLISHER is a strong entity with 'Publisher_ID' as the primary key.

AUTHOR is a strong entity with 'Author_ID' as the primary key.

BOOK is a strong entity with 'Book_ID' as the primary key

PERSON is a strong entity with 'PID' as the primary key.

PAYMENT is a strong entity with 'PaymentID' as the primary key.

MEMBER and EMPLOYEE are the subclasses of the Person entity with 'Member_ID' and 'Employee_ID' as the primary key referring to Person entity's primary key, PID.

MEMBER entity has two disjoint subclasses GOLD and SILVER entities with 'M_ID' as the primary key, respectively, referring to Member's primary key, Member_ID.

EMPLOYEE has three disjoint subclasses, LIBRARY_SUPERVISOR, RECEPTIONIST and CATALOGING_MANAGER with where each subclasses having a primary key 'LibSup_ID', 'Recep_ID' and 'CatMang_ID', respectively, referring to Employee's primary key, Employee_Id.

TRAINER is the union of LIBRARY_SUPERVISOR and CATALOGING_MANAGER entities where we have 'Trainer_ID' as primary key (surrogate key) and the participating classes have Trainer_ID as foreign key referring to TRAINER's primary key.

PERSON

PID_	FName	Middle Name	Lname	DOB	Gender	Address	Person_type

MEMBER

Member_ID	Membership_ type

GOLD

M_ID

SILVER

M_ID

RECEPTIONIST

Recep_ID

TRAINER

Trainer_ID

LIBRARY_SUPERVISOR

LibSup_ID	Trainer_ID

CATALOGING_MANAGER

CatMang_ID	Trainer_ID

EMPLOYEE

Employee_ID	Start_Date	Age	Type

BOOK

Book_ID	Title	Other_Info

PUBLISHER

Publisher_ID	Publisher_Name	Established_Year	Address

AUTHOR

Author_ID	Author_Name	Year_of_Operation	Style_of_Writing

CATEGORY

Category_Number

PAYMENT

Payment_ID	Amount	Time	PMethod

Step 2 : Mapping of Weak Entity

GUEST_LOG is a weak entity with owner entity, GOLD and the primary key of GUEST_LOG is combination of 'Guest_ID' and 'M_ID' with M_ID being a foreign key referring to the GOLD's primary key.

LIBRARY_CARD is a weak entity with owner entity MEMBER and the primary key of LIBRARY_CARD being 'Card_Num' and 'Member_ID' where Member_ID is the foreign key referring to the Member's primary key.

PROMOTION is another weak entity with owner entity LIBRARY_CARD and the primary key of weak entity are 'Code', 'Card_Num' and 'Member_ID ' where Card_Num & Member_ID attributes are the foreign key referring to the owner's primary keys.

GUEST_LOG

Guest_ID	M_ID	Fname	Middle_name	Lname	Address	Contact

LIBRARY_CARD

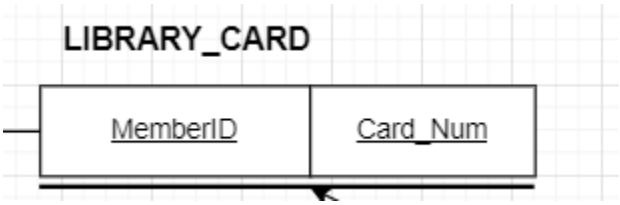
Member_ID	Card_Num

PROMOTION

Code	Member_ID	Card_Num	Description

Step 3 : Mapping of Binary 1:1 relationship types

'Issued' is 1:1 relationship between entities MEMBER and LIBRARY_CARD and this relationship have been handled before in the Step2 while mapping weak entity relationship by having MEMBER's primary key as a foreign key in LIBRARY_CARD entity.



Step 4 : Mapping of Binary 1:N relationship types

'Guest_Entry' relationship exists between GOLD and GUEST_ENTRY, therefore we add GOLD's primary key as foreign key in GUEST_ENTRY.

'Book_Category' relationship between BOOK and CATEGORY entities is 1:N relationship, therefore we add 'Cat_No' as a foreign key in BOOK referring to CATEGORY's attribute

'Training' is 1:N relationship between TRAINER and RECEPTIONIST where we add Trainer_ID as a foreign key in RECEPTIONIST which refers to TRAINER's attribute.

RECEPTIONIST

Recep_ID	Trainer_ID

BOOK

Book_ID	Title	Other_Info	Category_number

GUEST_LOG

Guest_ID	M_ID	Fname	Middle_name	Lname	Address	Contact

Step 5 : Mapping of Binary M:N relationship types

'Comments_On' is M:N relationship between PERSON and BOOK, therefore we create a new relation COMMENTS_ON with primary key being the combination of primary keys of PERSON(PID) and BOOK(Book_ID) . They are also the foreign keys referring to the respective participating entities. Also, add Comment_time, Rating and Content to the relation.

'Publishes' is a M:N relationship between BOOK and PUBLISHER, therefore we create a new relation PUBLISHES with primary key as the combination of primary keys of BOOK(Book_ID) and PUBLISHER(Pub_ID).

'Writes' is another M:N relationship between BOOK and AUTHOR, therefore we create a new relation WRITES with primary key as the combination of primary keys of BOOK(Book_ID) and AUTHOR(Auth_ID)

'Catalog_Activity' is M:N relationship between CATEGORY and CATLOGING_MANAGER, so we create a new relation CATALOG_ACTIVITY with primary key as primary key of CATEGORY(Cat_ID) and primary of CATALOGING_MANAGER(CatMang_ID).

COMMENTS_ON

PID	Book_ID	Comment_Time	Rating	Content

PUBLISHES

Book_ID	Publisher_ID

WRITES

Book_ID	Author_ID

CATALOG_ACTIVITY

CatMangID	Category_Num

Step 6 : Mapping of Multivalued attribute

'Phone Number' is a multivalued attribute of PERSON entity, we create a relation PHONE_NUMBERS with primary as both PID and Phone_No with PID referring to the PERSON entity's PID.

PHONE_NUMBERS

PID	Phone_num

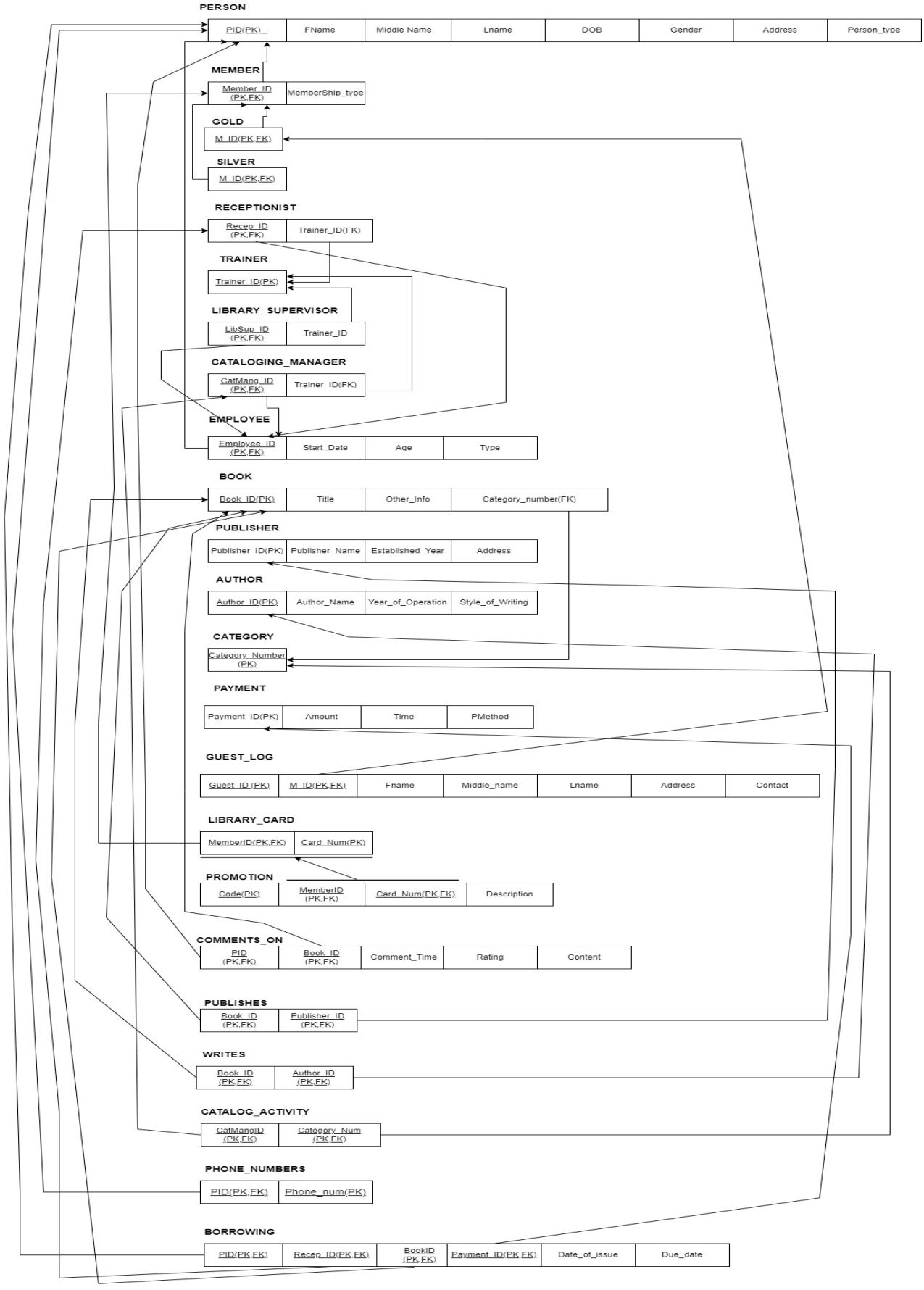
Step 7 : Mapping of N-Ary relationship Type

Borrowing' is a 4-ary relationship between PERSON, BOOK, RECEPTIONIST and PAYMENT entities, therefore we create a new relation BORROWING with PID, Book_Id, Recep_ID and Payment_ID

BORROWING

Person: PID	Recep_ID	BookID	Payment_ID	Date_of_issue	Due_date

The relational DBMS obtained after entire mapping is as below :


PERSON
PID(PK)__
FName
Middle Name
Lname
DOB
Gender
Address
Person_type
MEMBER
Member_ID (PK,FK)
MemberShip_type
GOLD
M_ID(PK,FK)
SILVER
M_ID(PK,FK)
RECEPTIONIST
Recep_ID (PK,FK)
Trainer_ID(FK)
TRAINER
Trainer_ID(PK)
LIBRARY_SUPERVISOR
LibSup_ID (PK,FK)
Trainer_ID
CATALOGING_MANAGER
CatMang_ID (PK,FK)
Trainer_ID(FK)
EMPLOYEE
Employee_ID (PK,FK)
Start_Date
Age
Type
BOOK
Book_ID(PK)
Title
Other_Info
Category_number(FK)
PUBLISHER
Publisher_ID(PK)
Publisher_Name
Established_Year
Address
AUTHOR
Author_ID(PK)
Author_Name
Year_of_Operation
Style_of_Writing
CATEGORY
Category_Number (PK)
PAYMENT
Payment_ID(PK)
Amount
Time
PMethod
GUEST_LOG
Guest_ID (PK)
M_ID(PK,FK)
Fname
Middle_name
Lname
Address
Contact
LIBRARY_CARD
MemberID(PK,FK)
Card_Num(PK)
PROMOTION
Code(PK)
MemberID (PK,FK)
Card_Num(PK,FK)
Description
COMMENTS_ON
PID (PK,FK)
Book_ID (PK,FK)
Comment_Time
Rating
Content
PUBLISHES
Book_ID (PK,FK)
Publisher_ID (PK,FK)
WRITES
Book_ID (PK,FK)
Author_ID (PK,FK)
CATALOG_ACTIVITY
CatMangID (PK,FK)
Category_Num (PK,FK)
PHONE_NUMBERS
PID(PK,FK)
Phone_num(PK)
BORROWING
PID(PK,FK)
Recep_ID(PK,FK)
BookID (PK,FK)
Payment_ID(PK,FK)
Date_of_issue
Due_date

The primary keys for the relations are as below :

1) Person - PID
2) Member – Member_ID
3) Gold – M_ID
4) Silver – M_ID
5) Receptionist – Recep_ID
6) Trainer – Trainer_ID
7) Library_Supervisor – LibSup_ID
8) Cataloging_Manager – CatMang_ID
9) Employee – Employee_ID
10) Book – Book_ID
11) Publisher - Publisher_ID
12) Author – Author_ID
13) Category - Category_Num
14) Payment – Payment_ID
15) Guest_Log – {Guest_ID, M_ID }
16) Library_Card – {MemberID, CardNum}
17) Promotion - {Code, MemberID, CardNum}
18) Comments_On – {PID, BookID}
19) Publishes – {BookID, , PublisherID}
20) Writes – {BookID, Author_ID}
21) Catalog_Activity – {CatMangID, Category_Num}
22) Phone Numbers – {PID, Phone_num}
23) Borrowing – { PID, BookID, RecepID, Payment_ID }

The Foreign keys for the relations are as below :

1) Member – Member_ID references PID of PERSON
2) Gold – M_ID references Member_ID of MEMBER
3) Silver – M_ID references Member_ID of MEMBER
4) Receptionist – Recep_ID references Employee_ID of EMPLOYEE, Trainer_ID references Trainer_ID of TRAINER
5) Library_Supervisor – LibSup_ID references Employee_ID of EMPLOYEE , Trainer_ID references Trainer_ID of TRAINER
6) Cataloging_Manager – CatMang_ID references Employee_ID of EMPLOYEE, Trainer_ID references Trainer_ID of TRAINER
7) Guest_Log – M_ID references M_ID of GOLD
8) Library_Card – MemberID references Member_ID of MEMBER
9) Promotion - {MemberID, CardNum} references {Member_ID,CardNum} of Library_Card
10) Comments_On – PID references PID of PERSON, BookID references BookID of BOOK
11) Publishes – BookID references BookID of BOOK, PublisherID references PublisherID of PUBLISHER
12) Writes – BookID references BookID of BOOK , Author_ID references AuthorID of AUTHOR
13) Catalog_Activity – CatMangID references CatMang_ID of CATALOGING_MANAGER, Category_Num references Category_Num of Category
14) Phone Numbers – PID references PID of PERSON
15) Borrowing – PID references PID of PERSON, BookID references BookID of BOOK , RecepID references Recep_ID of RECEPTIONIST, Payment_ID references Payment_ID of PAYMENT.