JIMMA UNIVERSITY

JIMMA INSTITUTE OF TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS

DEPARTMENT OF SOFTWARE ENGINEERING

ADVANCED DATABASE SYSTEMS PROJECT

TITLE: E-COMMERCE

Background

Introduction (Background)

E-commerce has dramatically transformed the global marketplace, revolutionizing the way businesses operate and consumers interact with products and services. By leveraging digital platforms, businesses can now reach a broader audience, break geographical barriers, and provide 24/7 accessibility. Customers, in turn, benefit from the convenience of shopping from their homes, access to diverse product options, and simplified purchasing processes. This paradigm shift has not only enhanced customer experiences but also fostered competitive innovation among businesses.

However, with the increasing complexity and scale of E-commerce operations, managing data efficiently has become a critical challenge. Key data management aspects include tracking user information, product inventories, orders, and customer interactions, which are essential for ensuring seamless functionality. A well-designed database architecture is the backbone of any successful E-commerce platform. It supports scalable data storage, quick retrieval, robust transaction handling, and consistent data integrity, which are vital for both operational and strategic decision-making.

The provided E-commerce project focuses on addressing these challenges by introducing a comprehensive database design built on relational principles and Entity-Relationship (ER) modeling. This design integrates key entities such as users, products, categories, orders, and shopping carts, along with their relationships. The system's capabilities encompass user management, product categorization, order placement, and the tracking of customer shopping behaviors. Each feature is underpinned by efficient query processing and data handling mechanisms to ensure high performance and reliability.

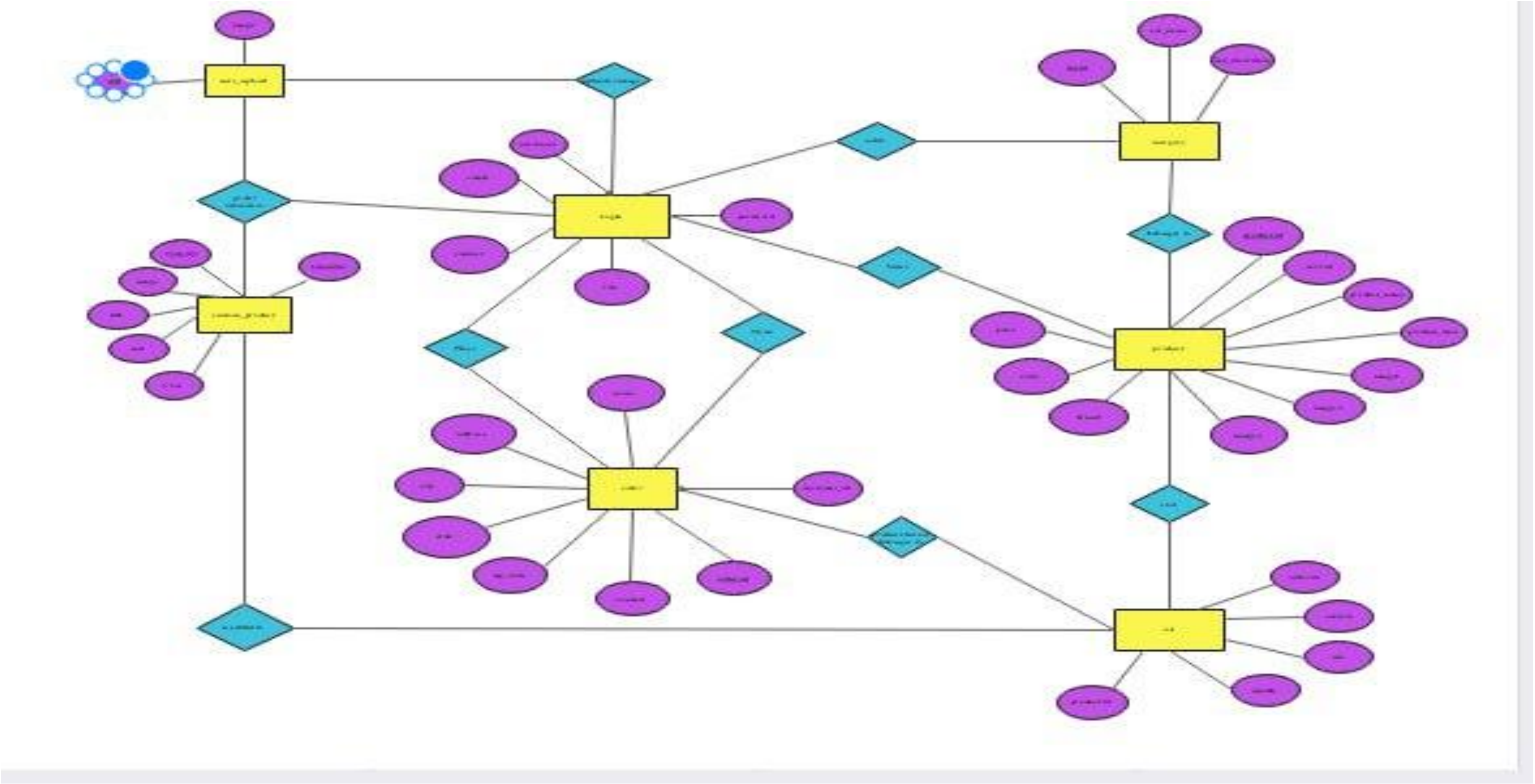
Additionally, the inclusion of vertical, horizontal, and mixed fragmentation techniques within the database structure enhances its adaptability and performance in distributed environments. These techniques allow data to be partitioned logically or physically based on usage patterns, further optimizing query efficiency and minimizing system latency.

In summary, this project serves as a practical demonstration of how an E-commerce platform can achieve operational efficiency and scalability through robust database architecture. It highlights the importance of thoughtful system design in meeting the dynamic demands of the digital marketplace while ensuring an exceptional experience for users and businesses alike.

Project Title : E-Commerce

Step 1. Entity-Relationship (ER) Diagram:

Our E-Commerce ER diagram provided here is , it typically includes entities (tables), relationships between entities, and attributes associated with each entity.



Entities and Attributes:

1. UserUpload: Stores user uploads, primarily images.

Attributes: UserID (Primary Key), Image

2. CustomerProducts: Links products with customers and users who uploaded the product-related data.

Attributes: ProductID (Primary Key), Title, Image, Cost

UserID (Foreign Key, references UserUpload.UserID)

CustomerID (Foreign Key, references Login.UserID)

3. Login: Manages user authentication and basic user details.

Attributes: UserID (Primary Key), Username, Email, Contact, Role, Password

4. Order: Stores information about customer orders.

Attributes:

OrderID (Primary Key), Name, Address, City, State, ZipCode, Contact

CustomerID (Foreign Key, references Login.UserID)

5. Category: Categorizes products into groups.

Attributes: CatID (Primary Key)**,** CatName**,** CatDescription

6. Product : Stores detailed information about products.

Attributes: ProductID (Primary Key)**,** Price**,** Color**,** Brand

CatID (Foreign Key, references Category.CatID), ProductName, ProductDesc

Image1, Image2, Image3

7. Cart : Represents items added to a customer's cart.

Attributes: OrderID (Primary Key), CustomerID (Foreign Key, references Login.UserID), Size, Quantity

ProductID (Foreign Key, references Product.ProductID)

Entity Relationship

1. User Upload ↔□ Custom Product

1. **Relationship:** Uploads
2. **Description:** A user uploads a custom product. Each User Upload (represented by uid) can be associated with multiple Custom Products.

2. Login ↔□ Category

1. **Relationship:** Views
2. **Description:** Users (represented by the Login entity) can view multiple categories of products. Similarly, a single category can be viewed by multiple users.

3. Category ↔□ Product

1. **Relationship:** Adds
2. **Description:** Each Category can have multiple Products, and each Product belongs to a specific category.

4. Login ↔□ Order

1. **Relationship:** Places
2. **Description:** Users (via Login) can place multiple Orders, but each order is placed by one user.

5. Order ↔□ Cart

1. **Relationship**: Is Added To
2. **Description:** An Order can have multiple Carts associated with it, each containing different products, sizes, or quantities.

6. Product ↔□ Cart

1. **Relationship:** Belongs To

2. **Description:** A Product can belong to multiple Carts, and a cart can contain multiple products.

7. Product ↔ Category

1. **Relationship**: Belongs To
2. **Description:** A Product belongs to a single Category, but a Category can include many products.

8. Cart ↔ Order

1. **Relationship:** Is Contained In
2. **Description:** A Cart is linked to a specific Order and represents the collection of products within that order.

9. Login ↔ Category

1. **Relationship Name**: Views
2. **Description**: Users represented by the Login entity can view multiple Categories. Similarly, each Category can be viewed by many users.

10. Login ↔ User Upload

1. **Relationship Name:** Uploads Image
2. **Description**: A user logged into the system can upload images of products via the User Upload entity. Each upload is linked to a specific user.

11. Login ↔ Custom Product

1. **Relationship Name:** Manages/Owns
2. **Description**: A user logged into the system can manage or own multiple Custom Products. Each product is associated with a specific user.

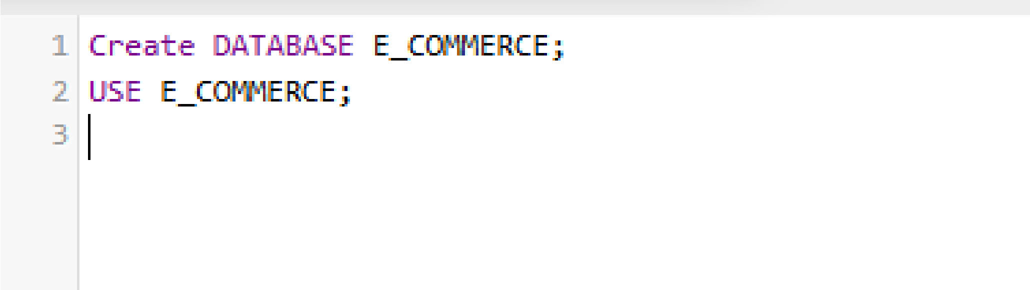
CODES

PART I Query processing

Creating a table and inserting into the table for the classes :

1 . Create DATABASE E_COMMERCE;

USE E_COMMERCE;



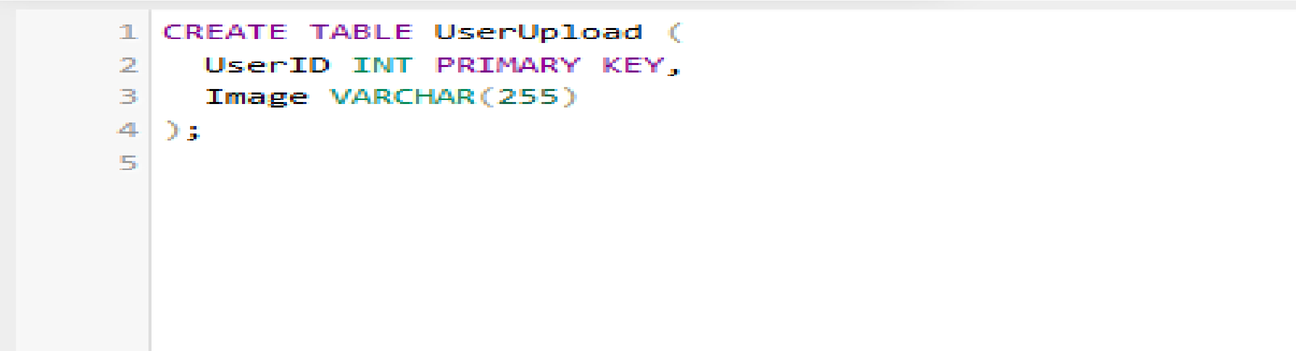
```
Create DATABASE E_COMMERCE;
USE E_COMMERCE;

```

2. CREATE TABLE UserUpload (

UserID INT PRIMARY KEY,

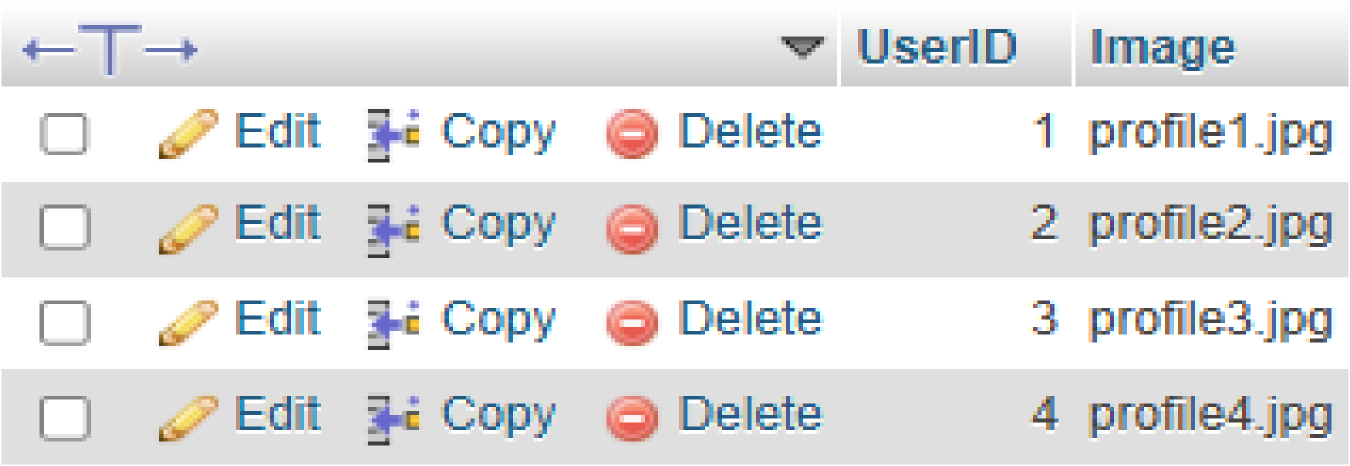
Image VARCHAR(255)

);



```
CREATE TABLE UserUpload (
  UserID INT PRIMARY KEY,
  Image VARCHAR(255)
);

```

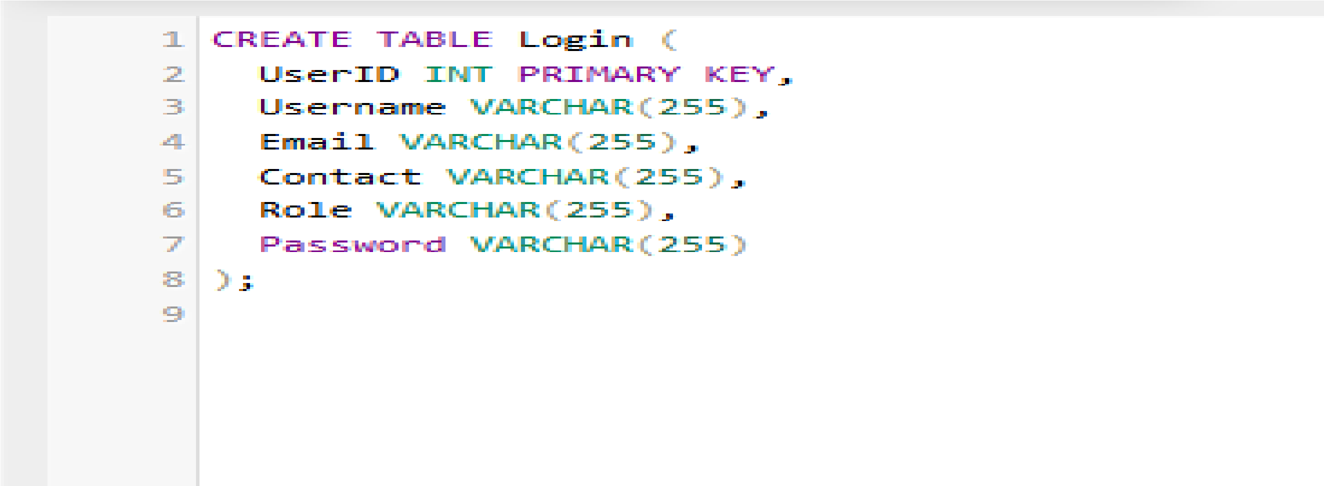
```
INSERT INTO UserUpload  (UserID, Image) VALUES (1, 'profile1.jpg');

INSERT INTO UserUpload  (UserID, Image) VALUES (2, 'profile2.jpg');

INSERT INTO UserUpload  (UserID, Image) VALUES (3, 'profile3.jpg');

INSERT INTO UserUpload  (UserID, Image) VALUES (4, 'profile4.jpg');
```



←T→			▼	UserID	Image
□	Edit	Copy	Delete	1	profile1.jpg
□	Edit	Copy	Delete	2	profile2.jpg
□	Edit	Copy	Delete	3	profile3.jpg
□	Edit	Copy	Delete	4	profile4.jpg

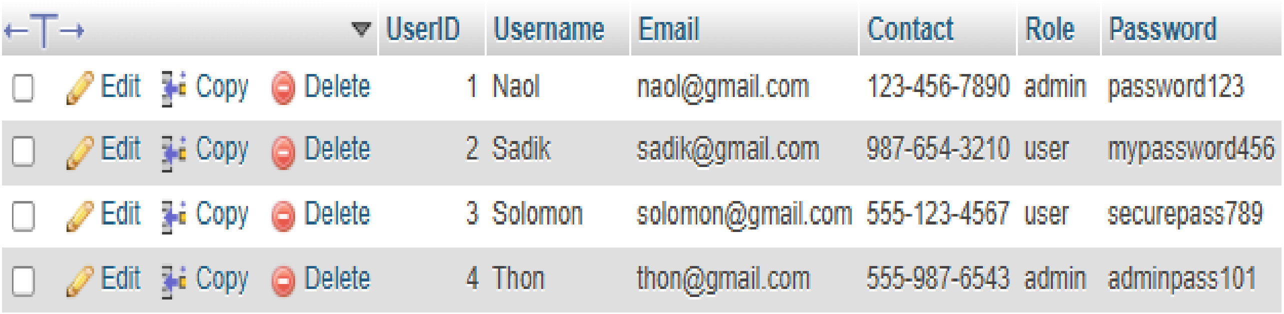
3.

```
CREATE TABLE Login (
  UserID INT PRIMARY KEY,
 Username VARCHAR(255),
 Email VARCHAR(255),
 Contact VARCHAR(255),
 Role VARCHAR(255),
Password VARCHAR(255));
```



```
CREATE TABLE Login (
  UserID INT PRIMARY KEY,
  Username VARCHAR(255),
  Email VARCHAR(255),
  Contact VARCHAR(255),
  Role VARCHAR(255),
  Password VARCHAR(255)
);
```

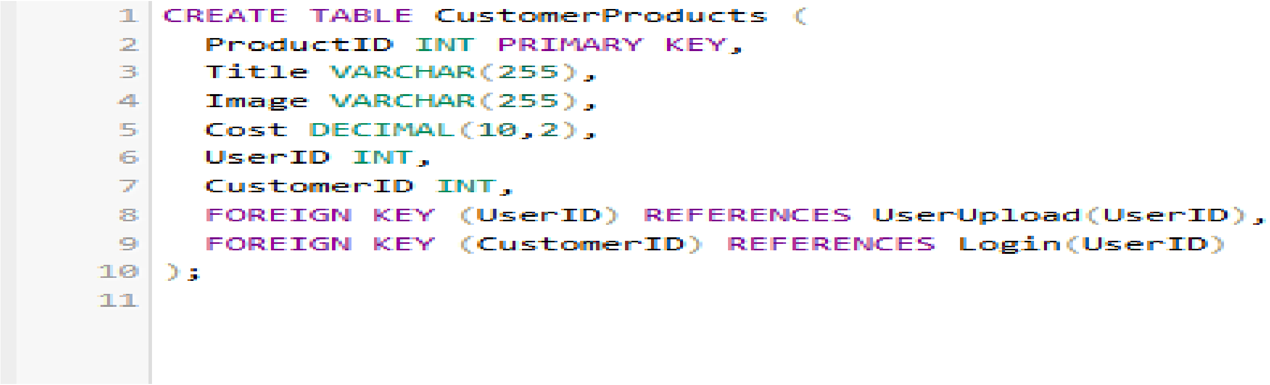
```
INSERT INTO Login (UserID, Username, Email, Contact, Role, Password)
VALUES (1, 'Naol', 'naol@gmail.com', '123-456-7890', 'admin', 'password123');
INSERT INTO Login (UserID, Username, Email, Contact, Role, Password)
VALUES  (2, 'Sadik', 'sadik@gmail.com', '987-654-3210', 'user', 'mypassword456');
INSERT INTO Login (UserID, Username, Email, Contact, Role, Password)
VALUES  (3, 'Solomon', 'solomon@gmail.com', '555-123-4567', 'user', 'securepass789');
INSERT INTO Login (UserID, Username, Email, Contact, Role, Password)
VALUES  (4, 'Thon', 'thon@gmail.com', '555-987-6543', 'admin', 'adminpass101');
```



←T→				UserID	Username	Email	Contact	Role	Password
□	Edit	Copy	Delete	1	Naol	naol@gmail.com	123-456-7890	admin	password123
□	Edit	Copy	Delete	2	Sadik	sadik@gmail.com	987-654-3210	user	mypassword456
□	Edit	Copy	Delete	3	Solomon	solomon@gmail.com	555-123-4567	user	securepass789
□	Edit	Copy	Delete	4	Thon	thon@gmail.com	555-987-6543	admin	adminpass101

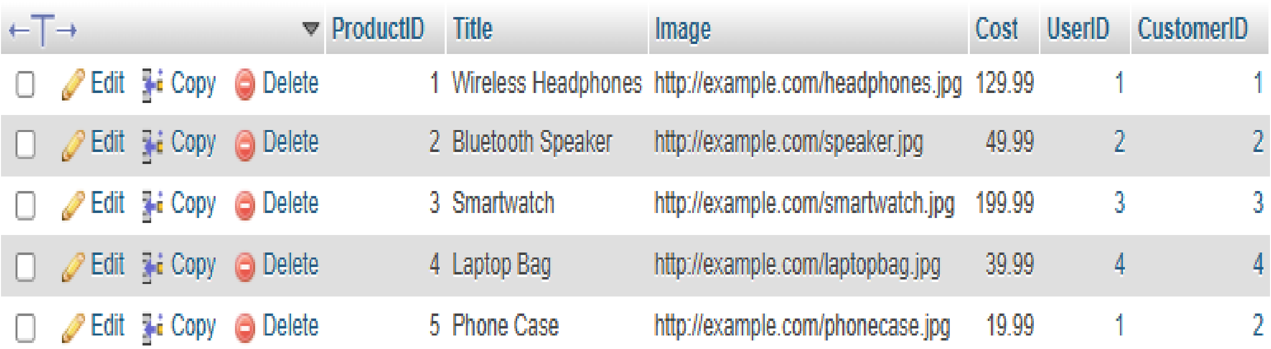
4.

```
CREATE TABLE CustomerProducts (
   ProductID INT PRIMARY KEY,
   Title VARCHAR(255),
   Image VARCHAR(255),
   Cost DECIMAL(10,2),
   UserID INT,
  CustomerID INT,
  FOREIGN KEY (UserID) REFERENCES UserUpload(UserID),
 FOREIGN KEY (CustomerID) REFERENCES Login(UserID)
  );
```



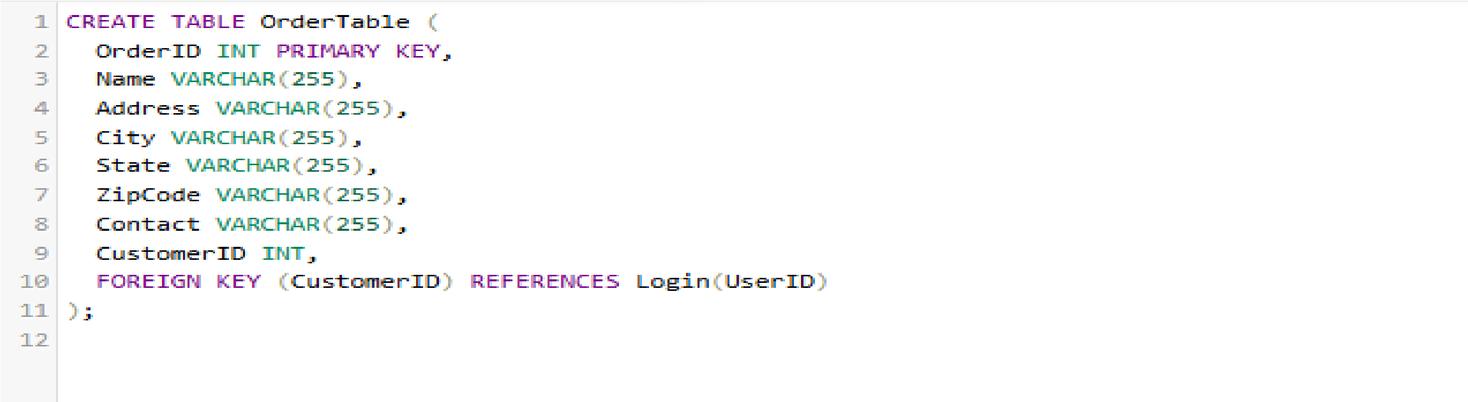
```
CREATE TABLE CustomerProducts (
   ProductID INT PRIMARY KEY,
   Title VARCHAR(255),
   Image VARCHAR(255),
   Cost DECIMAL(10,2),
   UserID INT,
   CustomerID INT,
   FOREIGN KEY (UserID) REFERENCES UserUpload(UserID),
   FOREIGN KEY (CustomerID) REFERENCES Login(UserID)
);
```

```
INSERT INTO CustomerProducts  (ProductID, Title, Image, Cost, UserID, CustomerID)
VALUES  (1, 'Wireless Headphones', 'http://example.com/headphones.jpg', 129.99, 1, 1);
INSERT INTO  CustomerProducts (ProductID, Title, Image, Cost, UserID, CustomerID)
VALUES  (2, 'Bluetooth Speaker', 'http://example.com/speaker.jpg', 49.99, 2, 2);
INSERT INTO CustomerProducts (ProductID, Title, Image, Cost, UserID, CustomerID)
VALUES  (3, 'Smartwatch', 'http://example.com/smartwatch.jpg', 199.99, 3, 3);
INSERT INTO CustomerProducts  (ProductID, Title, Image, Cost, UserID, CustomerID)
VALUES (4, 'Laptop Bag', 'http://example.com/laptopbag.jpg', 39.99, 4, 4);
INSERT INTO CustomerProducts (ProductID, Title, Image, Cost, UserID, CustomerID)
    VALUES (5, 'Phone Case', 'http://example.com/phonecase.jpg', 19.99, 1, 2);
```



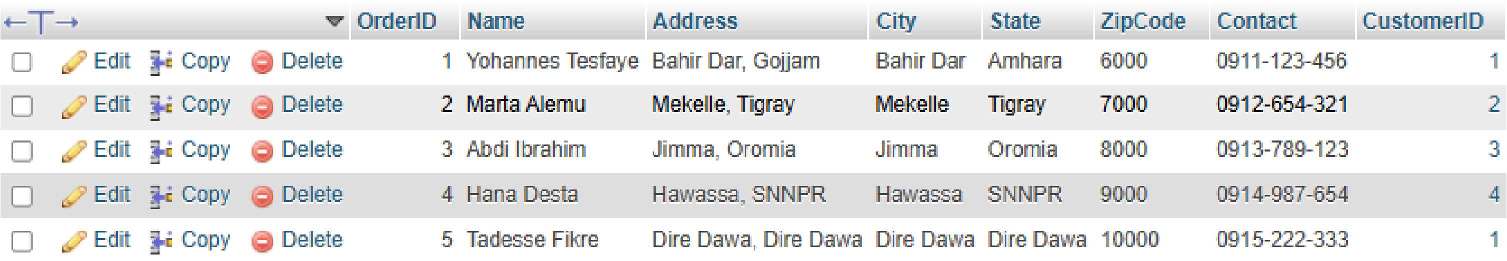
←T→	ProductID	Title	Image	Cost	UserID	CustomerID
□ Edit Copy Delete	1	Wireless Headphones	http://example.com/headphones.jpg	129.99	1	1
□ Edit Copy Delete	2	Bluetooth Speaker	http://example.com/speaker.jpg	49.99	2	2
□ Edit Copy Delete	3	Smartwatch	http://example.com/smartwatch.jpg	199.99	3	3
□ Edit Copy Delete	4	Laptop Bag	http://example.com/laptopbag.jpg	39.99	4	4
□ Edit Copy Delete	5	Phone Case	http://example.com/phonecase.jpg	19.99	1	2

```
5. CREATE TABLE OrderTable (
         OrderID INT PRIMARY KEY,
         Name VARCHAR(255),
         Address VARCHAR(255),
         City VARCHAR(255),
        State VARCHAR(255),
        ZipCode VARCHAR(255),
       Contact VARCHAR(255),
     CustomerID INT,
     FOREIGN KEY (CustomerID) REFERENCES Login(UserID)
);
```



```
CREATE TABLE OrderTable (
  OrderID INT PRIMARY KEY,
  Name VARCHAR(255),
  Address VARCHAR(255),
  City VARCHAR(255),
  State VARCHAR(255),
  ZipCode VARCHAR(255),
  Contact VARCHAR(255),
  CustomerID INT,
  FOREIGN KEY (CustomerID) REFERENCES Login(UserID)
);
```

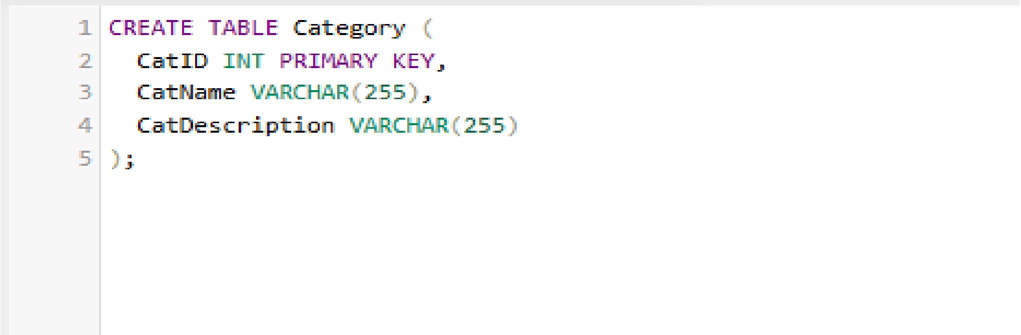
```
INSERT INTO OrderTable (OrderID, Name, Address, City, State, ZipCode, Contact, CustomerID)

VALUES  (1, 'Yohannes Tesfaye', 'Bahir Dar, Gojjam', 'Bahir Dar', 'Amhara', '6000', '0911-123-456', 1);

INSERT INTO OrderTable (OrderID, Name, Address, City, State, ZipCode, Contact, CustomerID)

VALUES  (2, 'Marta Alemu', 'Mekelle, Tigray', 'Mekelle', 'Tigray', '7000', '0912-654-321', 2);

INSERT INTO OrderTable (OrderID, Name, Address, City, State, ZipCode, Contact, CustomerID)

VALUES (3, 'Abdi Ibrahim', 'Jimma, Oromia', 'Jimma', 'Oromia', '8000', '0913-789-123', 3);

INSERT INTO OrderTable (OrderID, Name, Address, City, State, ZipCode, Contact, CustomerID)

VALUES (4, 'Hana Desta', 'Hawassa, SNNPR', 'Hawassa', 'SNNPR', '9000', '0914-987-654', 4);

INSERT INTO OrderTable (OrderID, Name, Address, City, State, ZipCode, Contact, CustomerID)

VALUES (5, 'Tadesse Fikre', 'Dire Dawa, Dire Dawa', 'Dire Dawa', 'Dire Dawa', '10000', '0915-222-333', 1);
```



←T→			▼	OrderID	Name	Address	City	State	ZipCode	Contact	CustomerID
□	Edit	Copy	Delete	1	Yohannes Tesfaye	Bahir Dar, Gojjam	Bahir Dar	Amhara	6000	0911-123-456	1
□	Edit	Copy	Delete	2	Marta Alemu	Mekelle, Tigray	Mekelle	Tigray	7000	0912-654-321	2
□	Edit	Copy	Delete	3	Abdi Ibrahim	Jimma, Oromia	Jimma	Oromia	8000	0913-789-123	3
□	Edit	Copy	Delete	4	Hana Desta	Hawassa, SNNPR	Hawassa	SNNPR	9000	0914-987-654	4
□	Edit	Copy	Delete	5	Tadesse Fikre	Dire Dawa, Dire Dawa	Dire Dawa	Dire Dawa	10000	0915-222-333	1

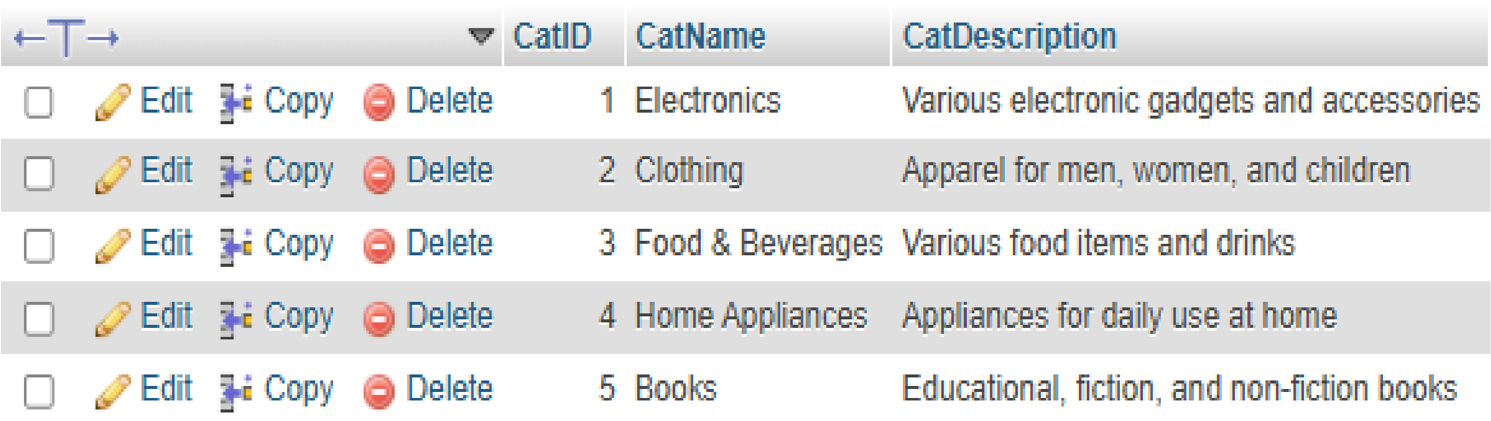
**6 .	CREATE TABLE Category (**

CatID INT PRIMARY KEY,



```
CREATE TABLE Category (
  CatID INT PRIMARY KEY,
  CatName VARCHAR(255),
  CatDescription VARCHAR(255)
);
```

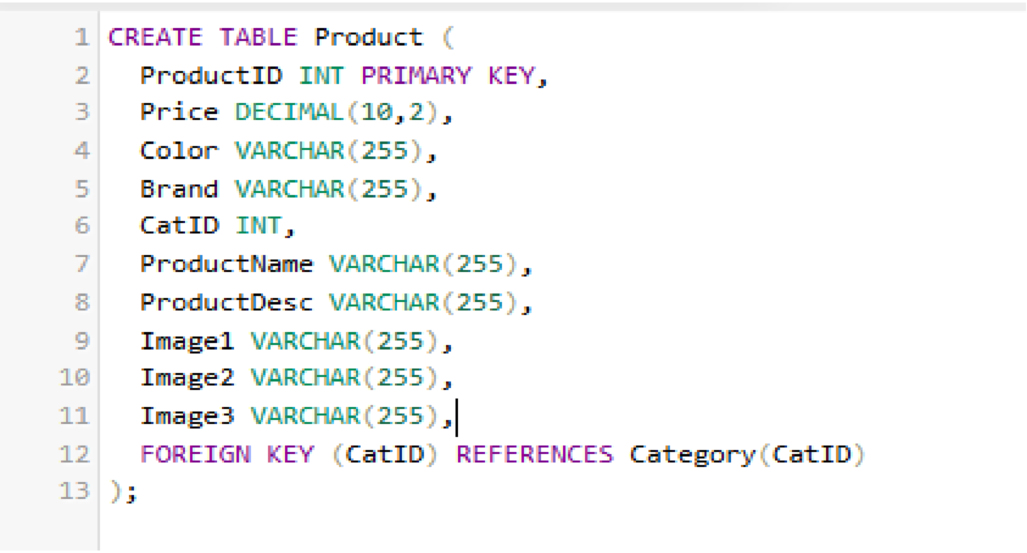
```
        CatName VARCHAR(255),

        CatDescription VARCHAR(255) );

 INSERT INTO Category (CatID, CatName, CatDescription)

VALUES (1, 'Electronics', 'Various electronic gadgets and accessories');

INSERT INTO Category (CatID, CatName, CatDescription)

VALUES (2, 'Clothing', 'Apparel for men, women, and children');

INSERT INTO Category (CatID, CatName, CatDescription)

VALUES (3, 'Food & Beverages', 'Various food items and drinks');

INSERT INTO Category (CatID, CatName, CatDescription)

VALUES (4, 'Home Appliances', 'Appliances for daily use at home');

INSERT INTO Category (CatID, CatName, CatDescription)

VALUES (5, 'Books', 'Educational, fiction, and non-fiction books');
```



←T→			▼	CatID	CatName	CatDescription
□	Edit	Copy	Delete	1	Electronics	Various electronic gadgets and accessories
□	Edit	Copy	Delete	2	Clothing	Apparel for men, women, and children
□	Edit	Copy	Delete	3	Food & Beverages	Various food items and drinks
□	Edit	Copy	Delete	4	Home Appliances	Appliances for daily use at home
□	Edit	Copy	Delete	5	Books	Educational, fiction, and non-fiction books

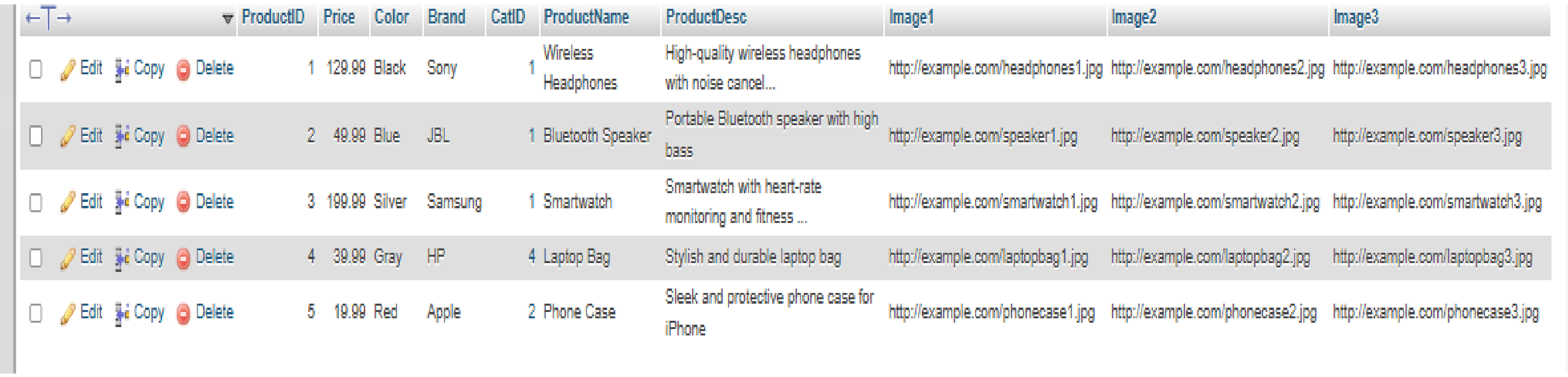
7 .

```
CREATE TABLE Product (

 ProductID INT PRIMARY KEY,

 Price DECIMAL(10,2),

 Color VARCHAR(255),

 Brand VARCHAR(255),

 CatID INT,

 ProductName VARCHAR(255),

 ProductDesc VARCHAR(255),

 Image1 VARCHAR(255),

 Image2 VARCHAR(255),

 Image3 VARCHAR(255),

 FOREIGN KEY (CatID) REFERENCES Category(CatID)

);
```



```
CREATE TABLE Product (
  ProductID INT PRIMARY KEY,
  Price DECIMAL(10,2),
  Color VARCHAR(255),
  Brand VARCHAR(255),
  CatID INT,
  ProductName VARCHAR(255),
  ProductDesc VARCHAR(255),
  Image1 VARCHAR(255),
  Image2 VARCHAR(255),
  Image3 VARCHAR(255),
  FOREIGN KEY (CatID) REFERENCES Category(CatID)
);
```

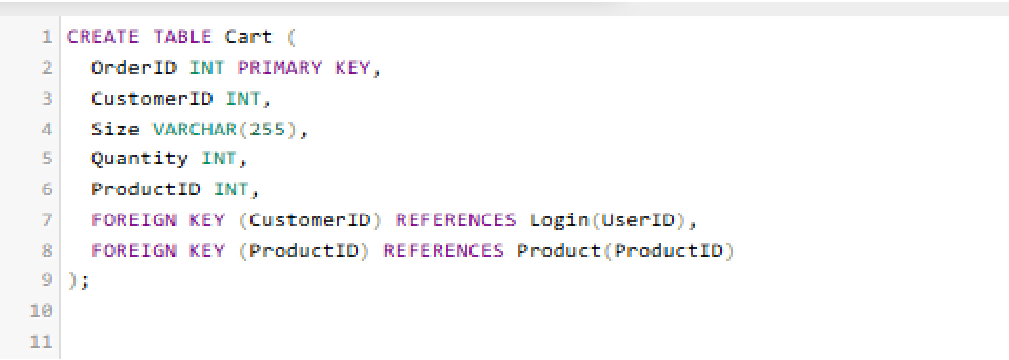
```
INSERT INTO Product (ProductID, Price, Color, Brand, CatID, ProductName, ProductDesc, Image1, Image2, Image3)

VALUES  (1, 129.99, 'Black', 'Sony', 1, 'Wireless Headphones', 'High-quality wireless headphones with noise cancellation',
'http://example.com/headphones1.jpg', 'http://example.com/headphones2.jpg', 'http://example.com/headphones3.jpg');

INSERT INTO Product (ProductID, Price, Color, Brand, CatID, ProductName, ProductDesc, Image1, Image2, Image3)

VALUES (2, 49.99, 'Blue', 'JBL', 1, 'Bluetooth Speaker', 'Portable Bluetooth speaker with high bass', 'http://example.com/speaker1.jpg',
'http://example.com/speaker2.jpg', 'http://example.com/speaker3.jpg');

INSERT INTO Product (ProductID, Price, Color, Brand, CatID, ProductName, ProductDesc, Image1, Image2, Image3)

VALUES (3, 199.99, 'Silver', 'Samsung', 1, 'Smartwatch', 'Smartwatch with heart-rate monitoring and fitness tracking',
'http://example.com/smartwatch1.jpg', 'http://example.com/smartwatch2.jpg', 'http://example.com/smartwatch3.jpg');

INSERT INTO Product (ProductID, Price, Color, Brand, CatID, ProductName, ProductDesc, Image1, Image2, Image3)

VALUES  (4, 39.99, 'Gray', 'HP', 4, 'Laptop Bag', 'Stylish and durable laptop bag', 'http://example.com/laptopbag1.jpg',
'http://example.com/laptopbag2.jpg', 'http://example.com/laptopbag3.jpg');

INSERT INTO Product (ProductID, Price, Color, Brand, CatID, ProductName, ProductDesc, Image1, Image2, Image3)

VALUES (5, 19.99, 'Red', 'Apple', 2, 'Phone Case', 'Sleek and protective phone case for iPhone', 'http://example.com/phonecase1.jpg',
'http://example.com/phonecase2.jpg', 'http://example.com/phonecase3.jpg');
```



←T→	ProductID	Price	Color	Brand	CatID	ProductName	ProductDesc	Image1	Image2	Image3
□ Edit Copy Delete	1	129.99	Black	Sony	1	Wireless Headphones	High-quality wireless headphones with noise cancel...	http://example.com/headphones1.jpg	http://example.com/headphones2.jpg	http://example.com/headphones3.jpg
□ Edit Copy Delete	2	49.99	Blue	JBL	1	Bluetooth Speaker	Portable Bluetooth speaker with high bass	http://example.com/speaker1.jpg	http://example.com/speaker2.jpg	http://example.com/speaker3.jpg
□ Edit Copy Delete	3	199.99	Silver	Samsung	1	Smartwatch	Smartwatch with heart-rate monitoring and fitness ...	http://example.com/smartwatch1.jpg	http://example.com/smartwatch2.jpg	http://example.com/smartwatch3.jpg
□ Edit Copy Delete	4	39.99	Gray	HP	4	Laptop Bag	Stylish and durable laptop bag	http://example.com/laptopbag1.jpg	http://example.com/laptopbag2.jpg	http://example.com/laptopbag3.jpg
□ Edit Copy Delete	5	19.99	Red	Apple	2	Phone Case	Sleek and protective phone case for iPhone	http://example.com/phonecase1.jpg	http://example.com/phonecase2.jpg	http://example.com/phonecase3.jpg

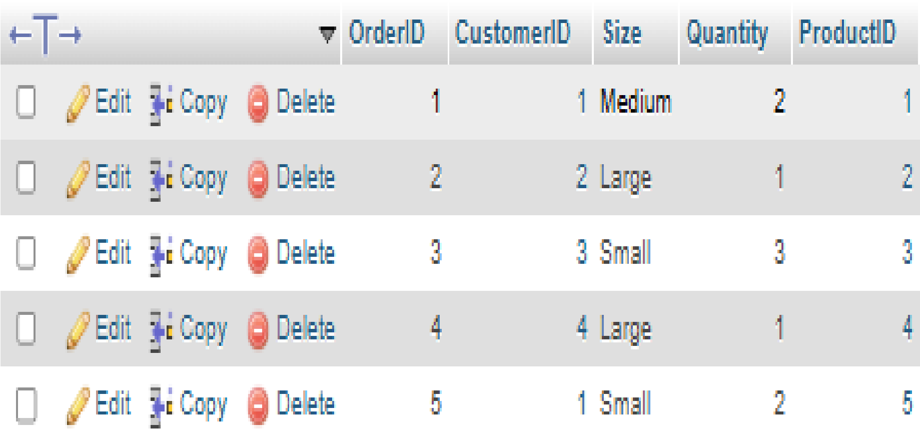
8.

```
CREATE TABLE Cart (

  OrderID INT PRIMARY KEY,

  CustomerID INT,

  Size VARCHAR(255),

  Quantity INT,

  ProductID INT,

  FOREIGN KEY (CustomerID) REFERENCES Login(UserID),

  FOREIGN KEY (ProductID) REFERENCES Product(ProductID)

);
```



```
CREATE TABLE Cart (
  OrderID INT PRIMARY KEY,
  CustomerID INT,
  Size VARCHAR(255),
  Quantity INT,
  ProductID INT,
  FOREIGN KEY (CustomerID) REFERENCES Login(UserID),
  FOREIGN KEY (ProductID) REFERENCES Product(ProductID)
);
```

```
INSERT INTO Cart (OrderID, CustomerID, Size, Quantity, ProductID)

VALUES (1, 1, 'Medium', 2, 1);

INSERT INTO Cart (OrderID, CustomerID, Size, Quantity, ProductID)

VALUES  (2, 2, 'Large', 1, 2);

INSERT INTO Cart (OrderID, CustomerID, Size, Quantity, ProductID)

VALUES (3, 3, 'Small', 3, 3);

INSERT INTO Cart (OrderID, CustomerID, Size, Quantity, ProductID)

VALUES (4, 4, 'Large', 1, 4);

INSERT INTO Cart (OrderID, CustomerID, Size, Quantity, ProductID)

VALUES (5, 1, 'Small', 2, 5);
```



←T→	▼	OrderID	CustomerID	Size	Quantity	ProductID
□	Edit Copy Delete	1	1	Medium	2	1
□	Edit Copy Delete	2	2	Large	1	2
□	Edit Copy Delete	3	3	Small	3	3
□	Edit Copy Delete	4	4	Large	1	4
□	Edit Copy Delete	5	1	Small	2	5

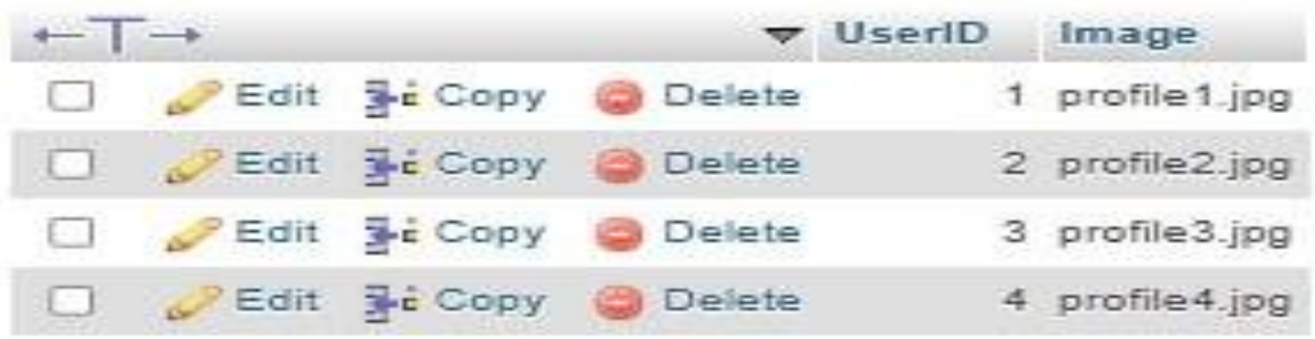
Conclusion

Vertical Fragmentation

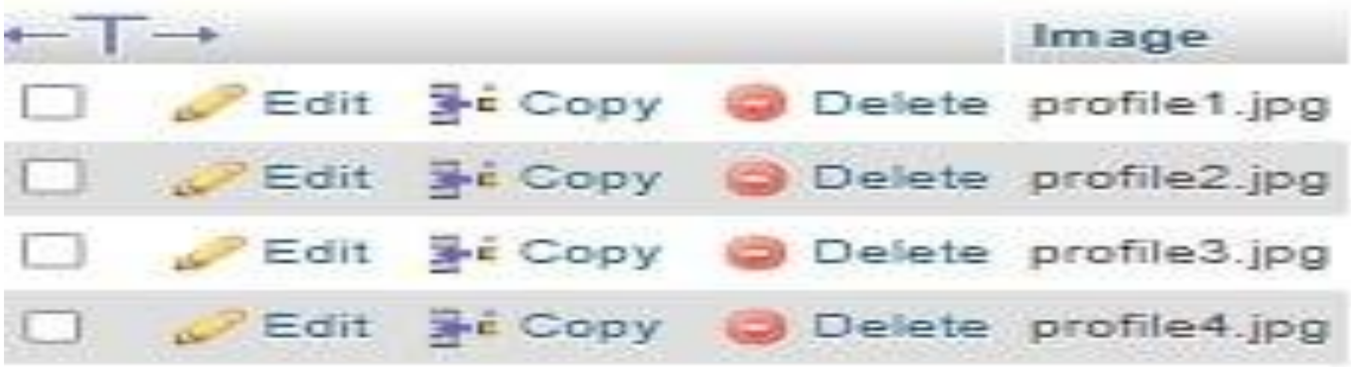
Vertical fragmentation involves dividing a table by selecting subsets of columns (attributes). For instance:

UserUpload Table:

Fragment 1: { UserID, Image}



←T→			▼	UserID	Image
□	Edit	Copy	Delete	1	profile1.jpg
□	Edit	Copy	Delete	2	profile2.jpg
□	Edit	Copy	Delete	3	profile3.jpg
□	Edit	Copy	Delete	4	profile4.jpg



←T→				Image
□	Edit	Copy	Delete	profile1.jpg
□	Edit	Copy	Delete	profile2.jpg
□	Edit	Copy	Delete	profile3.jpg
□	Edit	Copy	Delete	profile4.jpg

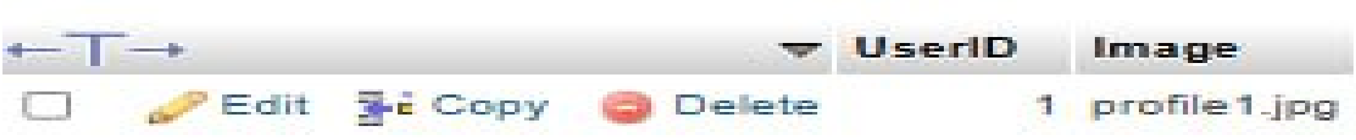
Horizontal Fragmentation

Horizontal fragmentation involves dividing a table into subsets of rows based on conditions. For example:

UserUpload Table:

Fragment 1: UserID <= 2

Fragment 2: UserID > 2



←T→				UserID	Image
☐	Edit	Copy	Delete	1	profile1.jpg

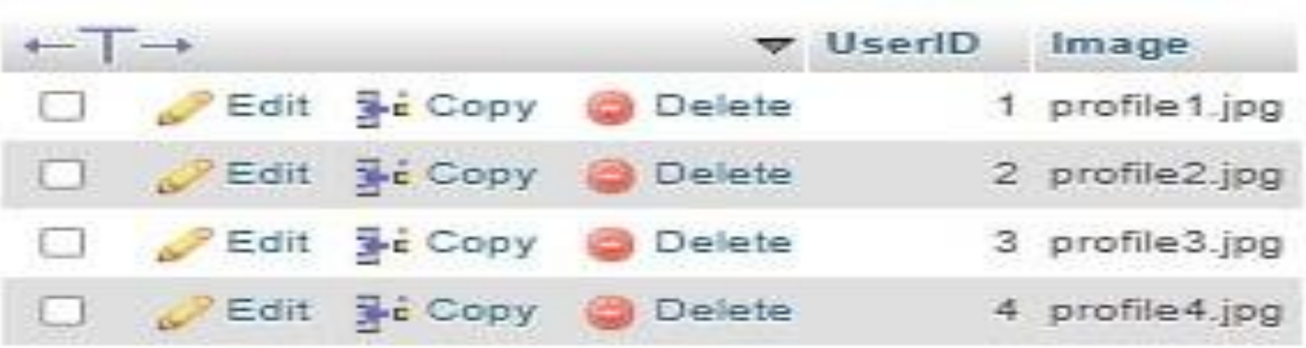
Mixed Fragmentation

Mixed fragmentation combines horizontal and vertical fragmentation. For instance:

UserUpload Table:

Fragment 1: UserID <= 2 with {UserID, Image}

Fragment 2: UserID > 2 with {UserID, Image}



←T→				UserID	Image
□	Edit	Copy	Delete	1	profile1.jpg
□	Edit	Copy	Delete	2	profile2.jpg
□	Edit	Copy	Delete	3	profile3.jpg
□	Edit	Copy	Delete	4	profile4.jpg

Appendix

ER Diagram

The ER diagram provides a graphical representation of the relationships between key entities:

UserUpload: Manages user-uploaded images.

Login: Handles user authentication and basic details.

CustomerProducts: Connects products with their respective users and customers.

OrderTable: Stores details about orders placed by customers.

Category: Categorizes products into specific groups.

Product: Maintains detailed information about available products.

Cart: Represents items added to a customer's cart.

Database Schema and Queries

The database schema includes structured tables with primary and foreign key constraints. Queries for data insertion and retrieval are provided, ensuring proper system functionality. Examples include:

Creating and populating tables like UserUpload, Login, CustomerProducts, OrderTable, Category, Product, and Cart.

Efficient data relationships through foreign keys, such as linking CustomerProducts to UserUpload and Login.

Conclusions

The E-commerce database design presented in this project serves as a comprehensive solution for managing a variety of business processes. By integrating key components such as users, products, orders, and categories, it ensures streamlined data flow and operational efficiency. The application of relational database principles, coupled with careful entity and relationship modeling, underscores the importance of structured data management in E-commerce systems. The inclusion of vertical, horizontal, and mixed fragmentation enhances data accessibility and performance in distributed environments. This project lays a strong foundation for scalable and user-friendly E-commerce platforms, meeting the dynamic demands of modern online markets.