**Entities**

**User:**

Attributes: User\_ID (Primary Key), Username, Email, Password, Full Name, Address, Phone Number, Account Balance, Registration Date.

Auction:

Attributes: Auction\_ID (Primary Key), Title, Description, Starting Bid, Reserve Price, Start Time, End Time, Status (Active, Completed, Closed), Seller\_ID (Foreign Key), Winner\_ID (Foreign Key, can be null), Creation Date.

**Bid:**

Attributes: Bid\_ID (Primary Key), Auction\_ID (Foreign Key), Bidder\_ID (Foreign Key), Bid Amount, Bid Time.

**Transaction:**

Attributes: Transaction\_ID (Primary Key), Auction\_ID (Foreign Key), Seller\_ID (Foreign Key), Buyer\_ID (Foreign Key), Transaction Amount, Transaction Date.

**Category:**

Attributes: Category\_ID (Primary Key), Category Name, Description.

**Image:**

Attributes: Image\_ID (Primary Key), Auction\_ID (Foreign Key), Image URL.

**Relationships:**

A User can have multiple Auctions as a seller.

User (1) <--> Auction (M)

A User can participate in multiple Bids.

User (1) <--> Bid (M)

An Auction can have multiple Bids from different users.

Auction (1) <--> Bid (M)

An Auction can have multiple Images.

Auction (1) <--> Image (M)

An Auction has one Seller (User).

Auction (1) <--> User (1)

An Auction has one Winner (User, if the auction is successful).

Auction (1) <--> User (0 or 1)

A Bid is placed by one Bidder (User).

Bid (1) <--> User (1)

A Transaction is associated with an Auction, a Seller, and a Buyer (User).

Transaction (1) <--> Auction (1)

Transaction (1) <--> User (Seller) (1)

Transaction (1) <--> User (Buyer) (1)

An Auction can belong to multiple Categories, and a Category can have multiple Auctions.

Auction (M) <--> Category (M) (Many-to-Many)

Attributes for Normalization:

To adhere to normalization rules, you should ensure that each table is in at least 3rd Normal Form (3NF). Here are some attributes that need to be considered while applying normalization rules:

**User Table:** All attributes are already in 1NF. No multi-valued or composite attributes are present.

**Auction Table:** Ensure that there are no partial or transitive dependencies. Split the table if necessary.

**Bid Table:** Verify that Bidder\_ID and Auction\_ID are both foreign keys and the Bid Amount attribute is atomic.

**Transaction Table:** Transaction Amount, Auction\_ID, Seller\_ID, and Buyer\_ID need to be atomic, and there should be no partial or transitive dependencies.

**Category Table:** Ensure that Category Name and Description are atomic attributes.

**Image Table:** The Image URL attribute should be atomic.