Contents

EBD: Database Specification Component

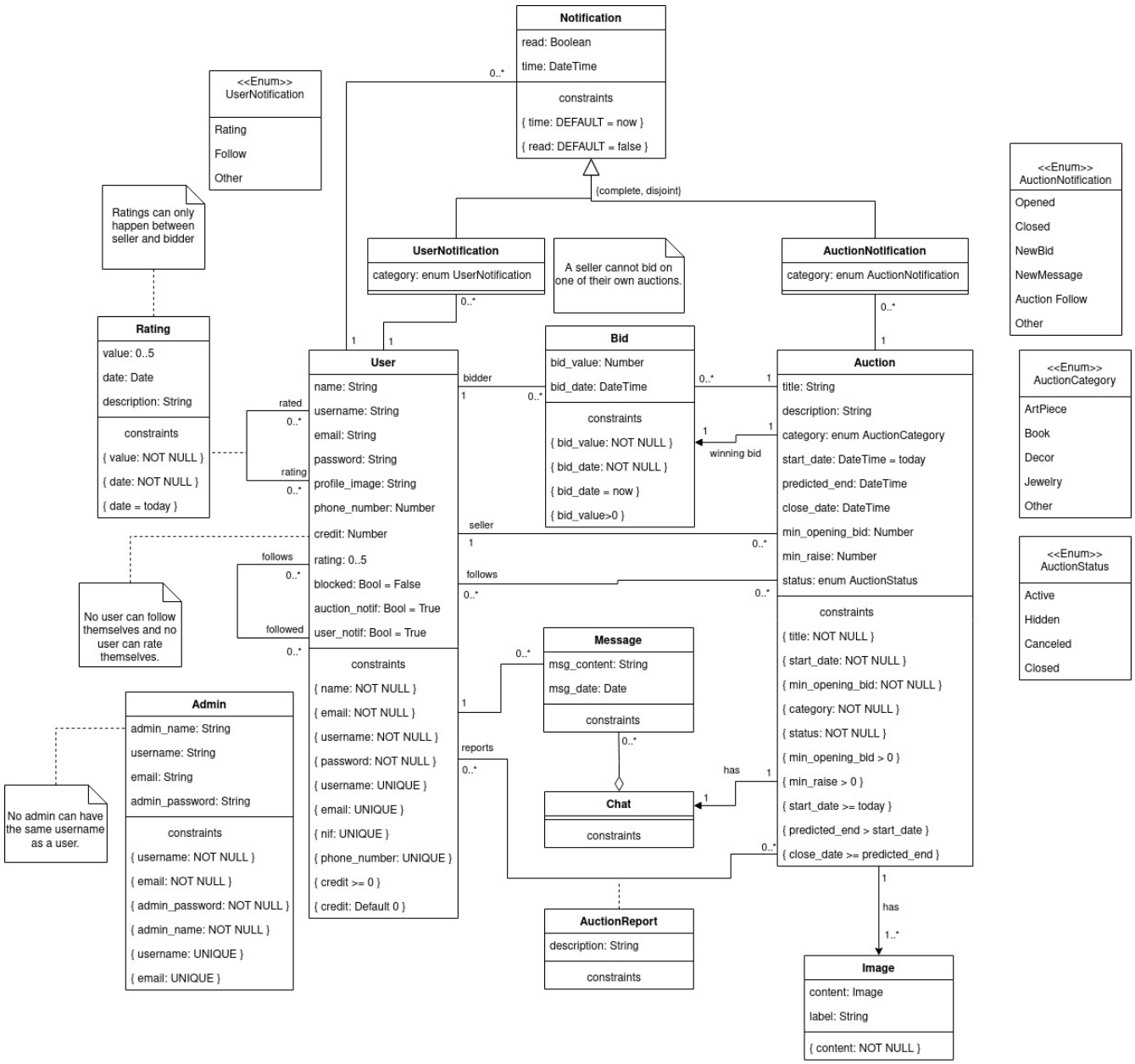
The project Hand of Midas is an online auction system available over the Web for users to buy and sell a variety of items .

A4: Conceptual Data Model

The Conceptual Domain Model contains the identification and description of the entities of the domain and the relationships between them in an UML class diagram.

1. Class diagram

UML class diagram containing the classes, associations, multiplicity and roles.
For each class, the attributes, associations and constraints are included in the class diagram.



2. Additional Business Rules

Business rules	Description
BR01	A user cannot put an item for auction if he cannot prove the ownership of said item.

A5: Relational Schema, validation and schema refinement

This artifact contains the Relational Schema obtained by mapping from the Conceptual Data Model.

1. Relational Schema

The Relational Schema includes the relation schemas, attributes, domains, primary keys, foreign keys and other integrity rules: UNIQUE, DEFAULT, NOT NULL, CHECK.

Relation schemas are specified in the compact notation:

Relation reference	Relation Compact Notation
R01	user(**user_id**, email UK NN, name NN, username NN UK, password NN, image, nif UK, phone_number UK, credit NN DF 0 CK credit > 0, profile_image, rating, blocked, auction_notif, user_notif)
R02	auction(**auction_id**, title NN, description, category, start_date NN, predicted_end NN CK predicted_end >= start_date, close_date CK close_date >= predicted_end, min_opening_bid NN CK min_opening_bid > 0, min_raise NN CK min_raise > 0, status NN, seller_id → user, auction_image → image, win_bid -> bid)
R03	bid(**bid_id**, bid_value NN ck value > 0, bid_date NN CK date > auction.start_date, auction_id → auction, bidder_id → user)
R04	admin(**admin_id**, admin_name NN, username NN, email NN, admin_password NN)
R05	message(**msg_id**, msg_content, msg_date, user_id → user, chat_id → chat)
R06	chat(**chat_id**, auction_id→auction)
R07	image(**img_id**, content NN, label)
R08	auction_report(description, **user_id → user**, **auction_id → auction**)
R09	rating(**id_rated** → user,**id_rates** → user NN, rate_value NN CK value > 0 && value < 5, rate_date NN CK date == today, description)
R10	user_follow(**id_followed** → user NN,**id_follower** → user NN CK id_followed != id_follower)
R11	action_follow(**id_followed** → auction NN,**id_follower** → user NN)
R12	user_notification(**notif_id**,notified_id → User,notifier_id → User, notif_read DF false, notif_time DF now, category)
R13	auction_notification(**notif_id**,notified_id → User,auctionId → Auction, anotif_read DF false, anotif_time DF now, anotif_category NN)

2. Domains

Specification of additional domains:

Domain Name	Domain Specification
Today	DATE DEFAULT CURRENT_DATE
AuctionNotification	'Opened', 'Closed', 'New Bid', 'New Message', 'Auction Follow', 'Other'
UserNotification	'Rating', 'Follow', 'Other'
AuctionStatus	'Active', 'Hidden', 'Canceled', 'Closed'
AuctionCategory	'ArtPiece', 'Book', 'Jewelry', 'Decor', 'Other'

3. Schema validation

To validate the Relational Schema obtained from the Conceptual Model, all functional dependencies are identified and the normalization of all relation schemas is accomplished.

TABLE R01	User
Keys	{ user_id }, { email }, {username}
Functional Dependencies:	
FD0101	{id} → {email, name, username, password, image, nif, phone_number, credit, profile_image, rating, blocked, auction_notif, user_notif}
FD0102	{email} → {user_id, name, username, password, image, nif, phone_number, credit, profile_image, rating, blocked, auction_notif, user_notif}
FD0103	{username} → {user_id, email, name, password, image, nif, phone_number, credit, profile_image, rating, blocked, auction_notif, user_notif}
NORMAL FORM	BCNF

TABLE R02	Auction
Keys	{ auction_id }
Functional Dependencies:	
FD0201	{ auction_id } → {title, description, category, start_date, predicted_end, close_date, min_opening_bid, min_raise, status, seller_id, auction_image}
NORMAL FORM	BCNF

TABLE R03	Bid
Keys	{ bid_id }
Functional Dependencies:	
FD0301	{ bid_id } → {bid_value, bid_date, auction_id, bidder_id}
NORMAL FORM	BCNF

TABLE R04	Admin
Keys	{ admin_id }
Functional Dependencies:	
FD0401	{ admin_id } → {admin_name, username, email, admin_password}
NORMAL FORM	BCNF

TABLE R05	Message
Keys	{ msg_id }
Functional Dependencies:	
FD0501	{ msg_id } → {msg_content, msg_date, user_id, chat_id}
NORMAL FORM	BCNF

TABLE R06	Chat
Keys	{ chat_id }
Functional Dependencies:	
FD0601	{ chat_id } → {auction_id}
NORMAL FORM	BCNF

TABLE R07	Image
Keys	{ img_id }
Functional Dependencies:	
FD0701	{ img_id } → {content, label}
NORMAL FORM	BCNF

TABLE R08	AuctionReport
Keys	{ auction_id, user_id }
Functional Dependencies:	
FD0801	{ auction_id, user_id } → {description}
...	...
NORMAL FORM	BCNF

TABLE R09	Rating
Keys	{ id_rated , id_rates }
Functional Dependencies:	
FD0901	{id_rated, id_rates} → {rate_value, rate_date, description}
NORMAL FORM	BCNF

TABLE R10	UserFollow
Keys	{ id_follower , id_followed }
NORMAL FORM	BCNF

TABLE R11	ActionFollow
Keys	{ id_follower , id_followed }
NORMAL FORM	BCNF

TABLE R12	UserNotification
Keys	{ notif_id }
Functional Dependencies:	
FD1201	{ notif_id } → {notified_id, notifier_id, notif_read, notif_time, category}
…	…
NORMAL FORM	BCNF

TABLE R13	AuctionNotification
Keys	{ notif_id }
Functional Dependencies:	
FD1301	{ notif_id } → {notified_id, auction_id, anotif_read, anotif_time, anotif_category}
NORMAL FORM	BCNF

As all relations schemas are in the Boyce–Codd Normal Form (BCNF), the relational schema is also in the BCNF and therefore there is no need to be refined using normalisation.

A6: Indexes, triggers, transactions and database population

This artefact contains the physical schema of the database, the identification and characterisation of the indexes, the support of data integrity rules with triggers and the definition of the database user-defined functions.

This artefact also contains the database's workload as well as the complete database creation script, including all SQL necessary to define all integrity constraints, indexes and triggers.

1. Database Workload

A study of the predicted system load (database load). Estimate of tuples at each relation.

Relation reference	**Relation Name**	**Order of magnitude**	**Estimated growth**
R01	Table1	units	dozens
R02	Table2	units	dozens

Relation reference	Relation Name	Order of magnitude	Estimated growth
R03	Table3	units	dozens
R04	Table4	units	dozens

2. Proposed Indices

2.1. Performance Indices

Indices proposed to improve performance of the identified queries.

Index	IDX01
Relation	Bid
Attribute	auction_id
Type	Hash
Cardinality	High
Clustering	Yes
Justification	Every time a auction page is opened we'll need to see the highest bid, and also for the auction history we'll need to have access to every bid made. Each auction has multiple bids, so cardinality is high. It's a good candidate for clustering.
SQL Code	

```
CREATE INDEX auction_bid_index on bid USING hash(auction_id);
```

Index	IDX02
Relation	Bid
Attribute	bidder_id
Type	Hash
Cardinality	High
Clustering	Yes
Justification	Every time a auction page is opened we'll need to see the highest bid, and also for the auction history we'll need to have access to every bid made. Each auction has multiple bids, so cardinality is high. It's a good candidate for clustering.
SQL Code	

```
CREATE INDEX user_bid_index on bid USING hash(bidder_id);
```

Index	IDX03
Relation	Auction
Attribute	start_date
Type	B-tree
Cardinality	Medium
Clustering	No
Justification	Table auction is frequently accessed when a item is searched. The auctions search reasults could be filtered by date. A b-tree index allows for faster date range queries based on the start date.
SQL Code	

```
CREATE INDEX auction_by_date ON auction USING btree (start_date);
```

2.2. Full-text Search Indices

The developed system will provide full-text search features supported by PostgreSQL.

Thus, the fields where full-text search will be available and the associated setup (all necessary configurations, indexes

definitions and other relevant details) are here specified.

Index	IDX01
Relation	auction, member
Attribute	{title, description, username, name}
Type	GIN
Clustering	No
Justification	To better the performance and results on FTS for auctions. Using GIN type because it will be accessed very frequently and rarely updated.
SQL Code	

```
SELECT auction.id, ts_auction(auction.ts_search, plainto_tsquery('english', $search_text));
FROM auction
        INNER JOIN auction_follow ON auction_follow.id_followed = auction.id AND auction_follow.follower_i
        INNER JOIN bid ON bid.auction_id = auction.id
    WHERE
        auction.category IN ($category1, $category2, ...) AND
        auction.status IN ($status1, $status2) AND
        bid.value >= min_opening_bid::money AND
        auction.ts_search @@ plainto_tsquery('english', $text_search)
    ORDER BY ts_auction DESC;

CREATE INDEX auction_search_idx USING GIN (ts_auction);||
```

Index	IDX01
Relation	member
Attribute	{username, name}
Type	GIN
Clustering	No
Justification	To better the performance and results on FTS for users. Using GIN type because it will be accessed very frequently and rarely updated.
SQL Code	

```
ALTER TABLE users ADD COLUMN tsvectors TSVECTOR;
CREATE FUNCTION u_search_update() RETURNS TRIGGER AS $$
BEGIN
IF TG_OP = 'INSERT' THEN
    NEW.tsvectors = (
        setweight(to_tsvector('english', NEW.username), 'A') ||
        setweight(to_tsvector('english', NEW.name), 'B')
    );
END IF;
IF TG_OP = 'UPDATE' THEN
    IF (NEW.username <> OLD.username OR NEW.name <> OLD.name) THEN
        NEW.tsvectors = (
        setweight(to_tsvector('english', NEW.username), 'A') ||
        setweight(to_tsvector('english', NEW.name), 'B')
        );
    END IF;
END IF;
RETURN NEW;
END $$
LANGUAGE plpgsql;

CREATE TRIGGER u_search_update
```

```
    BEFORE INSERT OR UPDATE ON users
    FOR EACH ROW
    EXECUTE PROCEDURE u_search_update();

CREATE INDEX users_search_idx USING GIN (tsvectors);||
```

3. Triggers

User-defined functions and trigger procedures that add control structures to the SQL language or perform complex computations, are identified and described to be trusted by the database server.

Trigger	TRIGGER01
Description	An Admin must not have the same username or email as a User

```
DROP FUNCTION IF EXISTS admin_diff_user CASCADE;
CREATE FUNCTION admin_diff_user() RETURNS TRIGGER AS
$BODY$
BEGIN
    IF EXISTS (SELECT username FROM users WHERE NEW.username = users.username) THEN
        RAISE EXCEPTION 'An Admin must not have the same username as a User.';
    END IF;
    IF EXISTS (SELECT email FROM users WHERE NEW.email = users.email) THEN
        RAISE EXCEPTION 'An Admin must not have the same email as a User';
    END IF;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS admin_diff_user on admin CASCADE;
CREATE TRIGGER admin_diff_user
    BEFORE INSERT OR UPDATE ON admin
    FOR EACH ROW
    EXECUTE PROCEDURE admin_diff_user();
```

Trigger	TRIGGER02
Description	A User must not have the same username nor email as an Admin

```
DROP FUNCTION IF EXISTS user_diff_admin CASCADE;
CREATE FUNCTION user_diff_admin() RETURNS TRIGGER AS
$BODY$
BEGIN
    IF EXISTS (SELECT * FROM admin WHERE NEW.username = admin.username) THEN
        RAISE EXCEPTION 'A User must not have the same username as an Admin.';
    END IF;
    IF EXISTS (SELECT * FROM admin WHERE NEW.email = admin.email) THEN
        RAISE EXCEPTION 'A User must not have the same email as an Admin';
    END IF;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS user_diff_admin on users CASCADE;
CREATE TRIGGER user_diff_admin
```

```
    BEFORE INSERT OR UPDATE ON users
    FOR EACH ROW
    EXECUTE PROCEDURE user_diff_admin();
```

Trigger	TRIGGER03
Description	A User cannot bid on one of their own auctions

```
DROP FUNCTION IF EXISTS user_bid CASCADE;
CREATE FUNCTION user_bid() RETURNS TRIGGER AS
$BODY$
BEGIN
    IF EXISTS (SELECT * FROM auction WHERE NEW.bidder_id = auction.seller_id AND NEW.auction_id = auction.
        RAISE EXCEPTION 'A user cannot bid on their own auction.';
    END IF;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS user_bid on bid CASCADE;
CREATE TRIGGER user_bid
    BEFORE INSERT OR UPDATE ON bid
    FOR EACH ROW
    EXECUTE PROCEDURE user_bid();
```

Trigger	TRIGGER04
Description	When an auction closes, the winning bid is set

```
DROP FUNCTION IF EXISTS win_bid CASCADE;
CREATE FUNCTION win_bid() RETURNS TRIGGER AS
$BODY$
DECLARE
    max_bid INTEGER;
    bid_idd INTEGER;
BEGIN
    SELECT max(bid_value) INTO max_bid FROM bid WHERE bid.auction_id = NEW.auction_id;
    SELECT bid_id INTO bid_idd FROM bid WHERE bid.bid_value = max_bid AND bid.auction_id = NEW.auction_id;
    IF (NEW.status = 'Closed') THEN
        NEW.win_bid = bid_idd;
    END IF;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS win_bid on bid CASCADE;
CREATE TRIGGER win_bid
    BEFORE UPDATE ON auction
    FOR EACH ROW
    EXECUTE PROCEDURE win_bid();
```

Trigger	TRIGGER05
Description	A User bid on an auction must be higher than the current highest

```
DROP FUNCTION IF EXISTS min_bid CASCADE;
CREATE FUNCTION min_bid() RETURNS TRIGGER AS
$BODY$
DECLARE
    max_bid INTEGER;
    min_inc INTEGER;
    min_bid INTEGER;
BEGIN
    SELECT max(bid_value) INTO max_bid FROM bid WHERE bid.auction_id = NEW.auction_id;
    SELECT min_raise INTO min_inc FROM auction WHERE NEW.auction_id = auction.auction_id;
    SELECT min_opening_bid INTO min_bid FROM auction WHERE NEW.auction_id = auction.auction_id;
    IF (min_bid > NEW.bid_value) THEN
        RAISE EXCEPTION 'New bid must be higher than the mininum opening bid';
    END IF;
    IF (max_bid + min_inc > NEW.bid_value) THEN
        RAISE EXCEPTION 'New bid must be higher than all the previous bids plus the minimum raise';
    END IF;

    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS min_bid on bid CASCADE;
CREATE TRIGGER min_bid
    BEFORE INSERT ON bid
    FOR EACH ROW
    EXECUTE PROCEDURE min_bid();
```

Trigger	TRIGGER06
Description	When an auction gets a new bid, the close_date gets increased

```
DROP FUNCTION IF EXISTS extend_auction CASCADE;
CREATE FUNCTION extend_auction() RETURNS TRIGGER AS
$BODY$
BEGIN
    UPDATE auction
    SET close_date = close_date + integer '1' --mudar?
    WHERE auction_id = NEW.auction_id;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS extend_auction on bid CASCADE;
CREATE TRIGGER extend_auction
    BEFORE INSERT ON bid
    FOR EACH ROW
    EXECUTE PROCEDURE extend_auction();
```

Trigger	TRIGGER07
Description	When User receives rating, their rating is updated

```
DROP FUNCTION IF EXISTS new_rating CASCADE;
CREATE FUNCTION new_rating() RETURNS TRIGGER AS
```

```
$BODY$
DECLARE
    rate_count INTEGER;
BEGIN
    SELECT COUNT(*) INTO rate_count FROM rating
    WHERE rating.id_rated = NEW.id_rated;

    UPDATE users
        SET rating = ((users.rating * rate_count)+NEW.rate_value)/(rate_count+1)
        WHERE users.user_id = NEW.id_rated;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_rating on bid CASCADE;
CREATE TRIGGER new_rating
    BEFORE INSERT ON rating
    FOR EACH ROW
    EXECUTE PROCEDURE new_rating();
```

Trigger	TRIGGER08
Description	When a User changes their rating of another User, the rating of the rated user is updated

```
DROP FUNCTION IF EXISTS update_rating CASCADE;
CREATE FUNCTION update_rating() RETURNS TRIGGER AS
$BODY$
DECLARE
    rate_count INTEGER;
BEGIN
    SELECT COUNT(*) INTO rate_count FROM rating
    WHERE rating.id_rated = NEW.id_rated;

    UPDATE users
        SET rating = ((users.rating * rate_count) - OLD.rate_value + NEW.rate_value)/(rate_count)
        WHERE users.user_id = NEW.id_rated;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS update_rating on bid CASCADE;
CREATE TRIGGER update_rating
    BEFORE UPDATE ON rating
    FOR EACH ROW
    EXECUTE PROCEDURE update_rating();
```

Trigger	TRIGGER09
Description	When a User removes their rating of another User, the rating of the previously rated user is updated

```
DROP FUNCTION IF EXISTS delete_rating CASCADE;
CREATE FUNCTION delete_rating() RETURNS TRIGGER AS
$BODY$
DECLARE
```

```
    rate_count INTEGER;
BEGIN
    SELECT COUNT(*) INTO rate_count FROM rating
    WHERE rating.id_rated = NEW.id_rated;
    IF rate_count > 0 THEN
        UPDATE users
        SET rating = ((users.rating * rate_count) - OLD.rate_value)/(rate_count-1)
        WHERE users.user_id = NEW.id_rated;
    ELSE
        UPDATE users
        SET rating = 0
        WHERE users.user_id = NEW.id_rated;
    END IF;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS delete_rating on bid CASCADE;
CREATE TRIGGER delete_rating
    AFTER DELETE ON rating
    FOR EACH ROW
    EXECUTE PROCEDURE delete_rating();
```

Trigger	TRIGGER10
Description	When a User is followed they must get a “Follow” user_notification

```
DROP FUNCTION IF EXISTS new_follow_notif CASCADE;
CREATE FUNCTION new_follow_notif() RETURNS TRIGGER AS
$BODY$
BEGIN
    INSERT INTO user_notification(notified_id, notifier_id, notif_category)
    VALUES (NEW.id_followed, NEW.id_follower,'Follow');
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_follow_notif on bid CASCADE;
CREATE TRIGGER new_follow_notif
    AFTER INSERT ON user_follow
    FOR EACH ROW
    EXECUTE PROCEDURE new_follow_notif();
```

Trigger	TRIGGER11
Description	When a User receives a rating they must get a “Rating” user_notification

```
DROP FUNCTION IF EXISTS new_rating_notif CASCADE;
CREATE FUNCTION new_rating_notif() RETURNS TRIGGER AS
$BODY$
BEGIN
    INSERT INTO user_notification(notified_id, notifier_id, notif_category)
    VALUES (NEW.id_rated, NEW.id_rates,'Rating');
    RETURN NEW;
END
```

```
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_rating_notif on bid CASCADE;
CREATE TRIGGER new_rating_notif
    AFTER INSERT ON rating
    FOR EACH ROW
    EXECUTE PROCEDURE new_rating_notif();
```

Trigger	TRIGGER12
Description	When a User follows an Auction, it's User gets a notification

```
DROP FUNCTION IF EXISTS new_auction_follow_notif CASCADE;
CREATE FUNCTION new_auction_follow_notif() RETURNS TRIGGER AS
$BODY$
DECLARE
    seller_id INTEGER;
BEGIN
    SELECT auction.seller_id INTO seller_id FROM auction
    WHERE auction.auction_id = NEW.id_followed;
    INSERT INTO auction_notification(notified_id, auction_id, anotif_category)
    VALUES (seller_id, NEW.id_followed,'Auction Follow');
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_auction_follow_notif on bid CASCADE;
CREATE TRIGGER new_auction_follow_notif
    AFTER INSERT ON auction_follow
    FOR EACH ROW
    EXECUTE PROCEDURE new_auction_follow_notif();
```

Trigger	TRIGGER13
Description	When an auction is created, all of the creater's followers get notified

```
DROP FUNCTION IF EXISTS new_auction_notif CASCADE;
CREATE FUNCTION new_auction_notif() RETURNS TRIGGER AS
$BODY$
DECLARE
    rec RECORD;
BEGIN
    FOR rec IN SELECT id_follower FROM user_follow
    WHERE id_followed = NEW.seller_id
    LOOP
        INSERT INTO auction_notification(notified_id, auction_id, anotif_category)
        VALUES(rec.id_follower,NEW.auction_id,'Opened');
    END LOOP;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_auction_notif on bid CASCADE;
CREATE TRIGGER new_auction_notif
```

```
    AFTER INSERT ON auction
    FOR EACH ROW
    EXECUTE PROCEDURE new_auction_notif();
```

Trigger	TRIGGER14
Description	When an auction is closed, all of the creator's followers get notified

```
DROP FUNCTION IF EXISTS auction_closed_notif CASCADE;
CREATE FUNCTION auction_closed_notif() RETURNS TRIGGER AS
$BODY$
DECLARE
    rec RECORD;
BEGIN
    FOR rec IN SELECT id_follower FROM user_follow
    WHERE id_followed = NEW.seller_id
    LOOP
        IF NEW.status = 'Closed' AND OLD.status = 'Active' THEN
            INSERT INTO auction_notification(notified_id, auction_id, anotif_category)
            VALUES(rec.id_follower,NEW.auction_id,'Closed');
        END IF;
    END LOOP;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS auction_closed_notif on bid CASCADE;
CREATE TRIGGER auction_closed_notif
    AFTER UPDATE ON auction
    FOR EACH ROW
    EXECUTE PROCEDURE auction_closed_notif();
```

Trigger	TRIGGER15
Description	When an auction's chat gets new message, all of that auction's followers get notified

```
DROP FUNCTION IF EXISTS new_message_notif CASCADE;
CREATE FUNCTION new_message_notif() RETURNS TRIGGER AS
$BODY$
DECLARE
    rec RECORD;
    auction_id INTEGER;
BEGIN
    SELECT chat.auction_id INTO auction_id FROM chat WHERE chat.chat_id = NEW.chat_id;
    FOR rec IN SELECT id_follower FROM auction_follow
    WHERE id_followed = auction_id
    LOOP
        INSERT INTO auction_notification(notified_id, auction_id, anotif_category)
        VALUES(rec.id_follower,auction_id,'New Message');
    END LOOP;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_message_notif on bid CASCADE;
```

```
CREATE TRIGGER new_message_notif
    AFTER INSERT ON message
    FOR EACH ROW
    EXECUTE PROCEDURE new_message_notif();
```

Trigger	TRIGGER16
Description	When an auction gets a new bid, all of that auction's bidders get notified

```
DROP FUNCTION IF EXISTS new_bid_notif CASCADE;
CREATE FUNCTION new_bid_notif() RETURNS TRIGGER AS
$BODY$
DECLARE
    rec RECORD;
BEGIN
    FOR rec IN SELECT bidder_id FROM bid
    WHERE bid.auction_id = NEW.auction_id
    LOOP
        INSERT INTO auction_notification(notified_id, auction_id, anotif_category)
        VALUES(rec.bidder_id,NEW.auction_id,'New Bid');
    END LOOP;
    RETURN NEW;
END
$BODY$
LANGUAGE plpgsql;

DROP TRIGGER IF EXISTS new_bid_notif on bid CASCADE;
CREATE TRIGGER new_bid_notif
    AFTER INSERT ON bid
    FOR EACH ROW
    EXECUTE PROCEDURE new_bid_notif();
```

4. Transactions

Transactions are used to assure the integrity of the data when multiple operations are necessary.

T01	Get highest bid and bid history
Justification	During this transaction, if a new bid is placed, the bid history and the highest bid might not match. This transaction only uses SELECT so, the isolation level is SERIALIZABLE READ ONLY.
Isolation level	SERIALIZABLE READ ONLY
SQL Code	

```
BEGIN TRANSACTION;
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE READ ONLY;

-- get bid history
SELECT member.username as username, bid.bid_value as value, bid.bid_date as "date"
    FROM bid
    INNER JOIN users
    ON users.user_id = bid.bidder_id AND bid.auction_id = $auction_id
    ORDER BY value DESC;

-- get highest bid
SELECT bid.bid_value as value
    FROM bid
```

```
    WHERE auction.auction_id = bid.auction_id
    ORDER BY value DESC LIMIT 1;

END TRANSACTION;
```

Annex A. SQL Code

The database scripts are included in this annex to the EBD component.

The database creation script and the population script should be presented as separate elements. The creation script includes the code necessary to build (and rebuild) the database. The population script includes an amount of tuples suitable for testing and with plausible values for the fields of the database.

This code should also be included in the group's git repository and links added here.

A.1. Database schema

A.2. Database population

Revision history

Changes made to the first submission: 1. Item 1 1. ..

GROUP21gg, DD/MM/2021

- Group member 1 name, email (Editor)
- Group member 2 name, email
- …