**A5: Relational Schema, validation and schema refinement**

This artefact contains the relational schema which is the translation of our UML conceptual model from the previous artefact and the Postgres SQL schema which is the translation of the relational schema.

**1. Relational Schema**  
   
This section includes the relational schema which is the translation of the UML conceptual model of the previous artefact.

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| --- | --- |
| **Relation reference** | **Relation Compact Notation** |
| R01 | users(id, username **UK NN**, first\_name, last\_name, password **NN**, email **UK NN**, zip-code, address, registration\_date **NN DF** Today, profile\_picture\_path, location -> city, rating **CK** rating >= 1.0 **and** rating <= 5.0 **DF** null, is\_administrator **DF** false) |
| R02 | cities(id, city **NN**, country\_id -> country **NN**) |
| R03 | countries(id, country) |
| R04 | bans(id, banned\_id -> users **NN**, admin -> users **NN**, ban\_start\_date **NN DF** Today, ban\_expiration\_date **NN CK** ban\_expiration\_date >= ban\_start\_date, ban\_reason **NN**) |
| R05 | auctions(id, item\_name **NN**, description **NN**, starting\_price **NN CK** starting\_price >= 0.0, current\_price **CK** current\_price >= 0.0 **DF** null, condition **NN**, publication\_date **NN DF** Today, end\_date **NN CK** end\_date > publication\_date, payment\_type **NN IN** Payment\_Types, shipping\_options **NN IN** Shipping\_Options, shipping\_cost **CK** shipping\_cost >= 0.0, images\_folder, owner\_id->user **NN***,* category\_id -> categories **NN**, city\_id -> cities **NN**) |
| R06 | categories(id, category) |
| R07 | bids(auction\_id -> auctions, bidder\_id -> users, bid\_amount **NN CK** > 0) |
| R08 | qas(id, question **NN**, answer, auction\_id -> auctions **NN**, questioner\_id -> users **NN**) |
| R09 | closed\_auctions(id -> auctions) |
| R10 | won\_auctions(id -> closed\_auctions, is\_successful\_transaction **NN DF** false, has\_winner\_complained **NN DF** false, winner\_id -> users **NN**) |
| R11 | reviews(id -> won\_auctions, rating **NN CK** rating >= 1 **and** rating <= 5 **and** rating is integer **NN**, description **NN**) |
| R12 | messages(id, subject **NN**, message **NN**, send\_date **NN DF** Today) |
| R13 | reports(id -> messages) |
| R14 | emails(id -> messages, has\_been\_opened **NN DF** false, receiver\_id->users **NN,** sender\_id->users **NN**) |
| R15 | wishlists(auction\_id -> auctions, user\_id -> users) |

where UK means UNIQUE KEY, NN means NOT NULL, DF means DEFAULT and CK means CHECK.  
   
   
**2. Domains**

|  |  |
| --- | --- |
| Today | TIME DEFAULT CURRENT\_TIME |
| Payment\_Types | ENUM(‘Paypal’, ‘Credit Card’, ‘Bank Transfer’, ‘Other’) |
| Shipping\_Options | ENUM(‘Domestic Shipping’, ‘International Shipping’, ‘No shipping’) |

**3. Function Dependencies and Schema Validation**

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| --- |
| **Table R01** (users) |
| **Keys**: {id}, {username}, {email} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0101 | {id} -> {username, first\_name, last\_name, password, email, zip-code, address, registration\_date, profile\_picture\_path, location, rating, is\_administrator} |
| FD0102 | {username} -> {id, first\_name, last\_name, password, email, zip-code, address, registration\_date, profile\_picture\_path, location, rating, is\_administrator} |
| FD0103 | {email} -> {id, username, first\_name, last\_name, password, zip-code, address, registration\_date, profile\_picture\_path, location, rating, is\_administrator} |
| **NORMAL FORM** | BCNF |

|  |
| --- |
| **Table R02** (cities) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0201 | {id} -> {city, country\_id} |
| **NORMAL FORM** | BCNF |

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| --- |
| **Table R03** (countries) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0301 | {id} -> {country} |
| **NORMAL FORM** | BCNF |

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| **Table R04** (bans) |
| **Keys**: {id}, {banned\_id, admin, ban\_start\_date} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0401 | {id} -> {banned\_id, admin, ban\_start\_date, ban\_expiration\_date, ban\_reason} |
| FD0402 | {banned\_id, admin, ban\_start\_date} -> {id, ban\_expiration\_date, ban\_reason} |
| **NORMAL FORM** | BCNF |

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| --- |
| **Table R05** (auctions) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0501 | {id} -> {item\_name, description, starting\_price, current\_price, condition, publication\_date, end\_date, payment\_type, shipping\_options, shipping\_cost, images\_folder, owner\_id, category\_id, city\_id} |
| **NORMAL FORM** | BCNF |

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| --- |
| **Table R06** (categories) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0601 | {id}->{category} |
| **NORMAL FORM** | BCNF |

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| **Table R07** (bids) |
| **Keys**: {auction\_id, bidder\_id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0701 | {auction\_id, bidder\_id} -> {bid\_amount} |
| **NORMAL FORM** | BCNF |

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| **Table R08** (qas) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD0801 | {id} -> {question, answer, auction\_id, questioner\_id} |
| **NORMAL FORM** | BCNF |

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| **Table R09** (closed\_auctions) |
| **Keys**: {id} |
| **Functional Dependencies** |

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| --- | --- |
| **NORMAL FORM** | BCNF |

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| **Table R10** (won\_auctions) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD1001 | {id} -> {is\_successful\_transaction, has\_winner\_complained, winner\_id} |
| **NORMAL FORM** | BCNF |

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| **Table R11** (reviews) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD1101 | {id} -> {rating, description} |
| **NORMAL FORM** | BCNF |

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| **Table R12** (messages) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD1201 | {id} -> {subject, message, send\_date} |
| **NORMAL FORM** | BCNF |

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| **Table R13** (reports) |
| **Keys**: {id} |
| **Functional Dependencies** |

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| --- | --- |
| **NORMAL FORM** | BCNF |

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| **Table R14** (emails) |
| **Keys**: {id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| FD1401 | {id} -> {has\_been\_opened, receiver\_id, sender\_id} |
| **NORMAL FORM** | BCNF |

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| **Table R15** (wishlists) |
| **Keys**: {auction\_id, user\_id} |
| **Functional Dependencies** |

|  |  |
| --- | --- |
| **NORMAL FORM** | BCNF |

As all relations are already in Boyce-Codd Normal Form (BCNF) there is no need to decompose them using normalisation.

**4. SQL Code**

[database.sql](https://github.com/afonsobspinto/lbaw1764/blob/master/databases/database.sql)

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| DROP TABLE IF EXISTS auctions CASCADE; DROP TABLE IF EXISTS bans CASCADE; DROP TABLE IF EXISTS bids CASCADE; DROP TABLE IF EXISTS categories CASCADE; DROP TABLE IF EXISTS cities CASCADE; DROP TABLE IF EXISTS countries CASCADE; DROP TABLE IF EXISTS "users" CASCADE; DROP TABLE IF EXISTS closed\_auctions CASCADE; DROP TABLE IF EXISTS emails CASCADE; DROP TABLE IF EXISTS messages CASCADE; DROP TABLE IF EXISTS qas CASCADE; DROP TABLE IF EXISTS reports CASCADE; DROP TABLE IF EXISTS reviews CASCADE; DROP TABLE IF EXISTS wishlists CASCADE; DROP TABLE IF EXISTS won\_auctions CASCADE;  CREATE TABLE auctions (  id serial PRIMARY KEY,  item\_name text NOT NULL,  description text,  starting\_price real NOT NULL CONSTRAINT starting\_price\_ck CHECK (starting\_price >0.0),  current\_price real DEFAULT null,  condition character(50) NOT NULL,  "publication\_date" date DEFAULT CURRENT\_TIMESTAMP,  end\_date date NOT NULL CONSTRAINT end\_date\_ck CHECK (end\_date > "publication\_date"),  TYPE character(25) NOT NULL,  OPTION character(25) NOT NULL,  CONSTRAINT payment\_type CHECK ((TYPE = ANY (ARRAY['PayPal'::text, 'Credit Card'::text, 'Bank Transfer'::text, 'Other'::text]))),  CONSTRAINT shipping\_options CHECK ((OPTION = ANY (ARRAY['Domestic Shipping'::text, 'International Shipping'::text, 'No shipping'::text]))),  shipping\_cost real CONSTRAINT shipping\_cost\_ck CHECK (shipping\_cost >0.0),  images\_folder path,  owner\_id integer NOT NULL,  category\_id integer NOT NULL,  city\_id integer NOT NULL );  CREATE TABLE bans (  id serial PRIMARY KEY,  banned\_id integer NOT NULL,  admin integer NOT NULL,  "ban\_start\_date" date DEFAULT CURRENT\_TIMESTAMP,  ban\_expiration\_date date CONSTRAINT banExpiration\_ck CHECK (ban\_expiration\_date>"ban\_start\_date"),  ban\_reason text NOT NULL );   CREATE TABLE bids (  id integer NOT NULL PRIMARY KEY,  bidder\_id integer, --CONSTRAINT bidder\_id\_ck CHECK (bidder\_id <> id.owner\_id),  bid\_amount integer NOT NULL );  CREATE TABLE categories ( id integer NOT NULL PRIMARY KEY, name character(50) );  CREATE TABLE cities (  id integer NOT NULL PRIMARY KEY,  city character(25) NOT NULL,  country\_id integer NOT NULL );  CREATE TABLE countries (  id integer NOT NULL PRIMARY KEY,  country character(25) );  CREATE TABLE "users" (  id integer NOT NULL PRIMARY KEY,  username character(50),  first\_name character(50),  last\_name character(50),  password character(50) NOT NULL,  email character(50) NOT NULL UNIQUE,  zip\_code character(25),  address character(50),  "registration\_date" date DEFAULT CURRENT\_TIMESTAMP,  profile\_picture\_path path,  location integer,  rating real CONSTRAINT rating\_ck CHECK (((rating > 1.0) AND (rating <= 5.0))),  is\_administrator boolean DEFAULT false );  CREATE TABLE closed\_auctions (  id integer NOT NULL PRIMARY KEY );  CREATE TABLE emails (  id integer NOT NULL PRIMARY KEY,  "has\_been\_opened" boolean DEFAULT false NOT NULL,  receiver\_id integer NOT NULL,  sender\_id integer NOT NULL );  CREATE TABLE messages (  id serial PRIMARY KEY,  subject text NOT NULL,  message text NOT NULL,  "send\_date" date DEFAULT CURRENT\_TIMESTAMP );  CREATE TABLE qas (  id serial PRIMARY KEY,  question text NOT NULL,  answer text,  auction\_id integer NOT NULL,  questioner\_id integer NOT NULL );  CREATE TABLE reports (  id integer NOT NULL PRIMARY KEY );  CREATE TABLE reviews (  id integer NOT NULL PRIMARY KEY,  rating integer NOT NULL CONSTRAINT rating\_ck CHECK (((rating > 0) OR (rating <= 5))),  description text NOT NULL );  CREATE TABLE wishlists (  auction\_id integer NOT NULL PRIMARY KEY,  id integer NOT NULL );  CREATE TABLE won\_auctions (  id integer NOT NULL PRIMARY KEY,  "is\_successful\_transaction" boolean DEFAULT false NOT NULL,  "has\_winner\_complained" boolean DEFAULT false NOT NULL,  winner\_id integer NOT NULL );              -- Foreign Keys  ALTER TABLE ONLY "users"  ADD CONSTRAINT user\_location\_fk FOREIGN KEY (location) REFERENCES cities(id) ON UPDATE CASCADE;  ALTER TABLE ONLY cities  ADD CONSTRAINT city\_country\_name\_fk FOREIGN KEY (country\_id) REFERENCES countries(id) ON UPDATE CASCADE;  ALTER TABLE ONLY bans  ADD CONSTRAINT ban\_banned\_id\_fk FOREIGN KEY (banned\_id) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY bans  ADD CONSTRAINT ban\_admin\_fk FOREIGN KEY (admin) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY auctions  ADD CONSTRAINT auction\_auction\_owner\_fk FOREIGN KEY (owner\_id) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY auctions  ADD CONSTRAINT auction\_category\_name\_fk FOREIGN KEY (category\_id) REFERENCES categories(id) ON UPDATE CASCADE;  ALTER TABLE ONLY auctions  ADD CONSTRAINT auction\_item\_location\_fk FOREIGN KEY (city\_id) REFERENCES cities(id) ON UPDATE CASCADE;  ALTER TABLE ONLY bids  ADD CONSTRAINT bid\_id\_fk FOREIGN KEY (id) REFERENCES auctions(id) ON UPDATE CASCADE;  ALTER TABLE ONLY bids  ADD CONSTRAINT bid\_bidder\_id\_fk FOREIGN KEY (bidder\_id) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY qas  ADD CONSTRAINT qa\_questioner\_id\_fk FOREIGN KEY (questioner\_id) REFERENCES "users"(id) ON UPDATE CASCADE;   ALTER TABLE ONLY qas  ADD CONSTRAINT qa\_id\_fk FOREIGN KEY (id) REFERENCES auctions(id) ON UPDATE CASCADE;  ALTER TABLE ONLY closed\_auctions  ADD CONSTRAINT closed\_auction\_id\_fk FOREIGN KEY (id) REFERENCES auctions(id) ON UPDATE CASCADE;  ALTER TABLE ONLY won\_auctions  ADD CONSTRAINT won\_auction\_id\_fk FOREIGN KEY (id) REFERENCES auctions(id) ON UPDATE CASCADE;   ALTER TABLE ONLY won\_auctions  ADD CONSTRAINT won\_auction\_auction\_winner\_fk FOREIGN KEY (winner\_id) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY reviews  ADD CONSTRAINT review\_id\_fk FOREIGN KEY (id) REFERENCES auctions(id) ON UPDATE CASCADE;   ALTER TABLE ONLY reports  ADD CONSTRAINT report\_id\_message\_fk FOREIGN KEY (id) REFERENCES messages(id) ON UPDATE CASCADE;  ALTER TABLE ONLY emails  ADD CONSTRAINT email\_id\_message\_fk FOREIGN KEY (id) REFERENCES messages(id) ON UPDATE CASCADE;  ALTER TABLE ONLY emails  ADD CONSTRAINT email\_receiver\_fk FOREIGN KEY (receiver\_id) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY emails  ADD CONSTRAINT email\_sender\_fk FOREIGN KEY (sender\_id) REFERENCES "users"(id) ON UPDATE CASCADE;  ALTER TABLE ONLY wishlists  ADD CONSTRAINT wishlist\_auction\_id\_fk FOREIGN KEY (auction\_id) REFERENCES auctions(id) ON UPDATE CASCADE;   ALTER TABLE ONLY wishlists  ADD CONSTRAINT wishlist\_username\_fk FOREIGN KEY (id) REFERENCES "users"(id) ON UPDATE CASCADE; |

**Revision history**  
   
Changes made to the first submission:

1. Rename table names to plural.
2. Change ids.
3. Update the syntax of the function dependencies.
4. Change the limit of some of the character constraints.
5. Change the date to current time.
6. Add Enums to SQL code

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