

A5: Modelo Relacional, validação e refinamento do esquema

Neste artefacto é apresentado o modelo relacional da plataforma Bookhub, que foi obtido a partir do modelo conceptual de dados previamente elaborado. Este artefacto tem, portanto, como principais objetivos a definição do esquema relacional e dos seus atributos, domínios, chaves primárias (*Primary Keys*), chaves estrangeiras (*Foreign Keys*) e outras regras de integridade.

1. Esquema Relacional

Para o esquema relacional foram consideradas todas as restrições presentes no esquema conceptual, excetuando algumas restrições, em particular referentes a datas, que só poderão ser exercidas recorrendo a *triggers*.

Abreviaturas:

- UK -> *UNIQUE KEY*
- NN -> *NOT NULL*
- DF -> *DEFAULT*
- CK -> *CHECK*

Referência da relação	Notação Compacta da Relação
R01	Administrator(id , username UK NN, password NN)
R02	Country(id , countryName UK NN)
R03	Member(id , address, age NN CK age >= 18, email UK NN, name NN, password NN, paypalEmail, phone NN, postalCode NN, username UK NN, dateCreated NN DF Today, status DF 'normal' CK status IN MemberStatus, dateBanned, dateSuspended, dateTerminated, idCountry → Country NN, idImage → Image)
R04	RequestedTermination(id , dateRequested NN DF Today, idMember -> Member NN)
R05	Auction(id , author NN, description NN, duration NN CK duration > 5, ISBN NN, title NN, dateCreated NN DF Today, status DF 'waitingApproval' CK status IN AuctionStatus, dateApproved, dateRemoved, idPublisher → Publisher, idLanguage -> Language NN, idSeller → Member NN)
R06	Category(id , categoryName UK NN)
R07	Publisher(id , publisherName UK NN)
R08	Language(id , language UK NN)
R09	CategoryAuction(idCategory -> Category, idAuction -> Auction)

R10	WishList(idBuyer -> Member, idAuction -> Auction)
R11	Bid(idBuyer -> Member, idAuction -> Auction, bidDate NN DF Today, bidValue CK bidValue>0.0)
R12	AuctionModification(id , dateRequested NN DF Today,newDescription, is_approved, dateApproved, idApprovedAuction -> Auction NN)
R13	Notification(id , dateSent NN DF Today, information, is_seen DF FALSE, dateSeen, idMember -> Member NN)
R14	NotificationAuction(idAuction ->Auction, idNotification -> Notification)
R15	Image(id , source UK NN, idAuction → Auction, idAuctionModification - >AuctionModification)
R16	Message(id , dateSent NN DF Today, text NN, idSender → Member NN, idReceiver → Member NN)
R17	Comment(id , datePosted NN DF Today, liked, text NN, is_removed DF FALSE, idParent → Comment, idSender → Member NN, idReceiver → Member NN)

2. Domínios

Especificação de domínios adicionais:

Nome	Especificação
Today	DATE DEFAULT CURRENT_DATE
MemberStatus	ENUM ('moderator', 'suspended', 'banned', 'normal','terminated')
AuctionStatus	ENUM ('approved', 'removed', 'waitingApproval')

3. Dependências Funcionais e validação do esquema

Para validar o esquema relacional obtido através do modelo conceptual, todas as dependências funcionais estão identificadas e o nível de normalização de cada relação foi identificado:

Tabela R01 (Administrator)	
Chaves: { id, username }	
Dependências Funcionais	
FD0101	{id} → {username, password}
FD0102	{username} → {id, password}
Forma Normal	BCNF

Tabela R02(Country)

Chaves: { id, countryName }	
Dependências Funcionais	
FD0201	{ id } → {countryName}
FD0202	{ countryName } → {id}
Forma Normal	BCNF

Tabela R03 (Member)	
Chaves: {id, email, username}	
Dependências Funcionais	
FD0301	{id} → {address, age, email, name, password, paypalEmail, phone, postalCode, username, dateCreated, status, dateBanned, dateSuspended, dateTerminated, idCountry, idImage}
FD0302	{email} → {id, address, age, name, password, paypalEmail, phone, postalCode, username, dateCreated, status, dateBanned, dateSuspended, dateTerminated, idCountry, idImage}
FD0303	{username} → {id, address, age, email, name, password, paypalEmail, phone, postalCode, dateCreated, status, dateBanned, dateSuspended, dateTerminated, idCountry, idImage}
Forma Normal	BCNF

Tabela R04 (RequestedTermination)	
Chaves: {id}	
Dependências Funcionais	
FD0401	{ id } → {dateRequested,idMember}
Forma Normal	BCNF

Tabela R05 (Auction)	
Chaves: {id}	
Dependências Funcionais	
FD0501	{id} → {author, description, duration, ISBN, title, dateCreated, status, dateApproved, dateRemoved, idLanguage, idPublisher, idSeller}
Forma Normal	BCNF

Tabela R06 (Category)

Chaves: {id, categoryName}	
Dependências Funcionais	
FD0601	{id} → {categoryName}
FD0601	{categoryName} → {id}
Forma Normal	BCNF

Tabela R07 (Publisher)	
Chaves: {id, publisherName}	
Dependências Funcionais	
FD0701	{id} → {publisherName}
FD0701	{publisherName} → {id}
Forma Normal	BCNF

Tabela R08 (Language)	
Chaves: {id, language}	
Dependências Funcionais	
FD0801	{id} → {language}
FD0801	{language} → {id}
Forma Normal	BCNF

Tabela R09 (CategoryAuction)	
Chaves: {idCategory , idAuction}	
Dependências Funcionais	
(none)	
Forma Normal	BCNF

Tabela R10 (WishList)	
Chaves: {idBuyer , idAuction}	
Dependências Funcionais	
(none)	
Forma Normal	BCNF

Tabela R11 (Bid)	
Chaves: {idBuyer , idAuction}	
Dependências Funcionais	
FD1101	{idBuyer , idAuction} → {bidDate, bidValue}
Forma Normal	BCNF

Tabela R12 (AuctionModification)	
Chaves: {id}	
Dependências Funcionais	
D1201	{id} → {dateRequested, newDescription, is_approved, dateApproved, idApprovedAuction}
Forma Normal	BCNF

Tabela R13 (Notification)	
Chaves: {id}	
Dependências Funcionais	
FD1301	{id} → {dateSent, information, is_seen, dateSeen, idMember}
Forma Normal	BCNF

Tabela R14 (NotificationAuction)	
Chaves: {idNotification, idAuction}	
Dependências Funcionais	
(none)	
Forma Normal	BCNF

Tabela R15 (Image)	
Chaves: {id, source}	
Dependências Funcionais	
FD1501	{id} → {source, idAuction, idAuctionModification}
FD1502	{source} → {id, idAuction, idAuctionModification}
Forma Normal	BCNF

Tabela R16 (Message)	
Chaves: {id}	
Dependências Funcionais	
FD1601	{id} → {dateSent, text, idSender, idReceiver}
Forma Normal	BCNF

Tabela R17 (Comment)	
Chaves: { id }	
Dependências Funcionais	
FD1701	{id} → {datePosted, liked, text, is_removed, idParent, idSender, idReceiver}
Forma Normal	BCNF

Como todos os esquemas de relações estão na forma normal *Boyce–Codd Normal Form* (BCNF), o modelo relacional encontra-se inteiramente normalizado, não tendo sido necessário realizar nenhuma normalizações extra.

4. SQL Code

Ficheiro [schema.sql](#) (requer acesso ao repositório GitHub do projeto)

```
DROP TABLE IF EXISTS Administrator CASCADE;
DROP TABLE IF EXISTS Country CASCADE;
DROP TABLE IF EXISTS Member CASCADE;
DROP TABLE IF EXISTS RequestedTermination CASCADE;
DROP TABLE IF EXISTS Auction CASCADE;
DROP TABLE IF EXISTS Category CASCADE;
DROP TABLE IF EXISTS Publisher CASCADE;
DROP TABLE IF EXISTS "Language" CASCADE;
DROP TABLE IF EXISTS CategoryAuction CASCADE;
DROP TABLE IF EXISTS WishList CASCADE;
DROP TABLE IF EXISTS Bid CASCADE;
DROP TABLE IF EXISTS AuctionModification CASCADE;
DROP TABLE IF EXISTS "Notification" CASCADE;
DROP TABLE IF EXISTS NotificationAuction CASCADE;
DROP TABLE IF EXISTS "Image" CASCADE;
DROP TABLE IF EXISTS "Message" CASCADE;
DROP TABLE IF EXISTS Comment CASCADE;
```

```
-----
--Tables
-----
```

```

--1
CREATE TABLE Administrator (
    id SERIAL NOT NULL,
    username text NOT NULL,
    password text NOT NULL
);

--2
CREATE TABLE Country (
    id SERIAL NOT NULL,
    countryName text NOT NULL
);

--3
CREATE TABLE Member (
    id SERIAL NOT NULL,
    "address" text,
    age SMALLINT NOT NULL CHECK (age>=18),
    email text NOT NULL,
    name text NOT NULL,
    password text NOT NULL,
    paypalEmail text,
    phone text NOT NULL,
    postalCode text NOT NULL,
    username text NOT NULL,
    dateCreated TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    member_status text NOT NULL DEFAULT 'normal'::text,
    dateBanned TIMESTAMP WITH TIME zone NOT NULL,
    dateSuspended TIMESTAMP WITH TIME zone NOT NULL,
    dateTerminated TIMESTAMP WITH TIME zone NOT NULL,
    idCountry INTEGER NOT NULL,
    idImage INTEGER,
    CONSTRAINT status_ck CHECK ((member_status = ANY (ARRAY['moderator'::text,
'suspended'::text, 'banned'::text, 'normal'::text, 'terminated'::text])))
);

--4
CREATE TABLE RequestedTermination (
    id SERIAL NOT NULL,
    dateRequested TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    idMember INTEGER NOT NULL
);

--5
CREATE TABLE Auction (
    id SERIAL NOT NULL,
    author text NOT NULL,
    description text NOT NULL,
    duration interval NOT NULL CHECK (duration > '00:05:00'::interval),
    ISBN text NOT NULL,

```

```

    title text NOT NULL,
    dateCreated TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    auction_status text NOT NULL DEFAULT 'waitingApproval'::text,
    dateApproved TIMESTAMP WITH TIME zone NOT NULL,
    dateRemoved TIMESTAMP WITH TIME zone NOT NULL,
    idPublisher INTEGER,
    idLanguage INTEGER NOT NULL,
    idSeller INTEGER NOT NULL,
    CONSTRAINT auction_status_ck CHECK ((auction_status = ANY
(ARRAY['approved'::text, 'removed'::text, 'banned'::text,
'waitingApproval'::text])))
);

--6
CREATE TABLE Category (
    id SERIAL NOT NULL,
    categoryName text NOT NULL
);

--7
CREATE TABLE Publisher (
    id SERIAL NOT NULL,
    publisherName text NOT NULL
);

--8

CREATE TABLE "Language" (
    id SERIAL NOT NULL,
    "language" text NOT NULL
);

--9

CREATE TABLE CategoryAuction (
    idCategory INTEGER NOT NULL,
    idAuction INTEGER NOT NULL
);

--10
CREATE TABLE WishList (
    idBuyer INTEGER NOT NULL,
    idAuction INTEGER NOT NULL
);

--11
CREATE TABLE Bid (
    idBuyer INTEGER NOT NULL,
    idAuction INTEGER NOT NULL,
    bidDate TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    bidValue REAL CHECK(bidValue > 0.0)
);

```



```

--12
CREATE TABLE AuctionModification (
    id SERIAL NOT NULL,
    dateRequested TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    newDescription text,
    is_approved boolean,
    dateApproved TIMESTAMP WITH TIME zone,
    idApprovedAuction INTEGER NOT NULL
);

--13
CREATE TABLE "Notification" (
    id SERIAL NOT NULL,
    dateSent TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    information text,
    is_seen boolean DEFAULT FALSE,
    dateSeen TIMESTAMP WITH TIME zone,
    idMember INTEGER NOT NULL
);

--14

CREATE TABLE NotificationAuction (
    idAuction INTEGER NOT NULL,
    idNotification INTEGER NOT NULL
);

--15
CREATE TABLE "Image" (
    id SERIAL NOT NULL,
    source text NOT NULL,
    idAuction INTEGER,
    idAuctionModification INTEGER
);

--16
CREATE TABLE "Message" (
    id SERIAL NOT NULL,
    dateSent TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,
    "text" text NOT NULL,
    idSender INTEGER NOT NULL,
    idReceiver INTEGER NOT NULL
);

--17
CREATE TABLE Comment (
    id SERIAL NOT NULL,
    datePosted TIMESTAMP WITH TIME zone DEFAULT now() NOT NULL,

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```

        liked boolean,
        "text" text NOT NULL,
        is_removed boolean DEFAULT FALSE,
        idParent INTEGER,
        idSender INTEGER NOT NULL,
        idReceiver INTEGER NOT NULL
    );

-----
--PRIMARY KEYS
-----

--1
ALTER TABLE ONLY Administrator
    ADD CONSTRAINT administrator_pkey PRIMARY KEY (id);

ALTER TABLE ONLY Administrator
    ADD CONSTRAINT administrator_username_key UNIQUE (username);

--2
ALTER TABLE ONLY Country
    ADD CONSTRAINT country_pkey PRIMARY KEY (id);

ALTER TABLE ONLY Country
    ADD CONSTRAINT countryName_key UNIQUE (countryName);

--3
ALTER TABLE ONLY Member
    ADD CONSTRAINT member_pkey PRIMARY KEY (id);

ALTER TABLE ONLY Member
    ADD CONSTRAINT member_key_email UNIQUE (email);

ALTER TABLE ONLY Member
    ADD CONSTRAINT member_key_username UNIQUE (username);

--4

ALTER TABLE ONLY RequestedTermination
    ADD CONSTRAINT requestedTermination_pkey PRIMARY KEY (id);

--5
ALTER TABLE ONLY Auction
    ADD CONSTRAINT auction_pkey PRIMARY KEY (id);

--6

ALTER TABLE ONLY Category
    ADD CONSTRAINT category_pkey PRIMARY KEY (id);

ALTER TABLE ONLY Category
    ADD CONSTRAINT categoryName_key UNIQUE (categoryName);

```

```

--7

ALTER TABLE ONLY Publisher
    ADD CONSTRAINT publisher_pkey PRIMARY KEY (id);

ALTER TABLE ONLY Publisher
    ADD CONSTRAINT publisherName_key UNIQUE (publisherName);

--8

ALTER TABLE ONLY "Language"
    ADD CONSTRAINT language_pkey PRIMARY KEY (id);

ALTER TABLE ONLY "Language"
    ADD CONSTRAINT language_key UNIQUE ("language");

--9

ALTER TABLE ONLY CategoryAuction
    ADD CONSTRAINT categoryAuction_pk PRIMARY KEY (idCategory, idAuction);

--10

ALTER TABLE ONLY WishList
    ADD CONSTRAINT wishList_pk PRIMARY KEY (idBuyer, idAuction);

--11

ALTER TABLE ONLY Bid
    ADD CONSTRAINT bid_pk PRIMARY KEY (idBuyer, idAuction);

--12

ALTER TABLE ONLY AuctionModification
    ADD CONSTRAINT auctionModification_pkey PRIMARY KEY (id);

--13

ALTER TABLE ONLY "Notification"
    ADD CONSTRAINT notification_pkey PRIMARY KEY (id);

--14

ALTER TABLE ONLY NotificationAuction
    ADD CONSTRAINT notificationAuction_pk PRIMARY KEY (idAuction,
idNotification);

--15

ALTER TABLE ONLY "Image"
    ADD CONSTRAINT image_pk PRIMARY KEY (id);

--16

ALTER TABLE ONLY "Message"
    ADD CONSTRAINT message_pk PRIMARY KEY (id);

```

```

--17

ALTER TABLE ONLY Comment
    ADD CONSTRAINT comment_pk PRIMARY KEY (id);

-----

--FOREIGN KEYS
-----

--3

ALTER TABLE ONLY Member
    ADD CONSTRAINT member_id_country_fk FOREIGN KEY (idCountry) REFERENCES
Country(id) ON UPDATE CASCADE;

ALTER TABLE ONLY Member
    ADD CONSTRAINT member_id_image_fk FOREIGN KEY (idImage) REFERENCES "Image"
(id) ON UPDATE CASCADE;

--4

ALTER TABLE ONLY RequestedTermination
    ADD CONSTRAINT requestedTermination_id_member_fk FOREIGN KEY (idMember)
REFERENCES Member(id) ON UPDATE CASCADE;

--5

ALTER TABLE ONLY Auction
    ADD CONSTRAINT auction_id_publisher_fk FOREIGN KEY (idPublisher)
REFERENCES Publisher(id) ON UPDATE CASCADE;

ALTER TABLE ONLY Auction
    ADD CONSTRAINT auction_id_language_fk FOREIGN KEY (idLanguage) REFERENCES
"Language"(id) ON UPDATE CASCADE;

ALTER TABLE ONLY Auction
    ADD CONSTRAINT auction_id_seller_fk FOREIGN KEY (idSeller) REFERENCES
Member(id) ON UPDATE CASCADE;

--9

ALTER TABLE ONLY CategoryAuction
    ADD CONSTRAINT categoryAuction_category_fk FOREIGN KEY (idCategory)
REFERENCES Category(id) ON UPDATE CASCADE;

ALTER TABLE ONLY CategoryAuction
    ADD CONSTRAINT categoryAuction_auction_fk FOREIGN KEY (idAuction)
REFERENCES Auction(id) ON UPDATE CASCADE;

--10

ALTER TABLE ONLY WishList

```

```

    ADD CONSTRAINT wishList_buyer_fk FOREIGN KEY (idBuyer) REFERENCES
Member(id) ON UPDATE CASCADE;

ALTER TABLE ONLY WishList
    ADD CONSTRAINT wishList_auction_fk FOREIGN KEY (idAuction) REFERENCES
Auction(id) ON UPDATE CASCADE;

--11
ALTER TABLE ONLY Bid
    ADD CONSTRAINT bid_buyer_fk FOREIGN KEY (idBuyer) REFERENCES Member(id) ON
UPDATE CASCADE;

ALTER TABLE ONLY Bid
    ADD CONSTRAINT bid_auction_fk FOREIGN KEY (idAuction) REFERENCES
Auction(id) ON UPDATE CASCADE;

--12

ALTER TABLE ONLY AuctionModification
    ADD CONSTRAINT auctionModification_id_member_fk FOREIGN KEY
(idApprovedAuction) REFERENCES Auction(id) ON UPDATE CASCADE;

--13
ALTER TABLE ONLY "Notification"
    ADD CONSTRAINT notification_id_member_fk FOREIGN KEY (idMember) REFERENCES
Member(id) ON UPDATE CASCADE;

--14

ALTER TABLE ONLY NotificationAuction
    ADD CONSTRAINT notificationAuction_notification_fk FOREIGN KEY
(idNotification) REFERENCES "Notification"(id) ON UPDATE CASCADE;

ALTER TABLE ONLY NotificationAuction
    ADD CONSTRAINT notificationAuction_auction_fk FOREIGN KEY (idAuction)
REFERENCES Auction(id) ON UPDATE CASCADE;

--15
ALTER TABLE ONLY "Image"
    ADD CONSTRAINT image_auctionModification_fk FOREIGN KEY
(idAuctionModification) REFERENCES AuctionModification(id) ON UPDATE CASCADE;

ALTER TABLE ONLY "Image"
    ADD CONSTRAINT image_auction_fk FOREIGN KEY (idAuction) REFERENCES
Auction(id) ON UPDATE CASCADE;

--16

ALTER TABLE ONLY "Message"
    ADD CONSTRAINT message_sender_fk FOREIGN KEY (idSender) REFERENCES
Member(id) ON UPDATE CASCADE;

```

```
ALTER TABLE ONLY "Message"  
    ADD CONSTRAINT message_receiver_fk FOREIGN KEY (idReceiver) REFERENCES  
Member(id) ON UPDATE CASCADE;  
  
--17  
  
ALTER TABLE ONLY Comment  
    ADD CONSTRAINT comment_parent_fk FOREIGN KEY (idParent) REFERENCES  
Comment(id) ON UPDATE CASCADE;  
  
ALTER TABLE ONLY Comment  
    ADD CONSTRAINT comment_sender_fk FOREIGN KEY (idSender) REFERENCES  
Member(id) ON UPDATE CASCADE;  
  
ALTER TABLE ONLY Comment  
    ADD CONSTRAINT comment_receiver_fk FOREIGN KEY (idReceiver) REFERENCES  
Member(id) ON UPDATE CASCADE;
```

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