# A5: Relational Schema, validation and schema refinement - LearnIt (Q&A)

In this artifact, the Relational Schema obtained by mapping from the Conceptual Data Model is presented. It includes the relation schema, attributes, domains, primary keys, foreign keys and other integrity rules, such as UNIQUE KEY (UK), DEFAULT (DF), NOT NULL (NN) and CHECK (CK).

## Relational schema

Below is the relation schema, in compact notation, for the LearnIt system. Apart from the notation already described above, primary key attributes are underlined and foreign keys attributes in the form attr → origin\_table.

|  |  |
| --- | --- |
| R01 | User (id\_user, username UK NN, password NN, email UK NN, bioDescription, birthdate NN, profilePhoto NN DF defaultPhoto, banned NN, deleted NN, points NN CK points >=0, id\_rank → Rank NN, id\_role → Role NN) |
| R02 | Follow (follower → User, following → User) |
| R03 | Role (id\_role, type **NN DF** member **CK** type **IN** RoleType, beginningDate, endDate **CK** endDate > beginningDate) |
| R04 | Rank (id\_rank,name **UK NN DF** rookie **CK** name **IN** RankType , minValue **CK** minValue >= 0, maxValue **CK** maxValue > 0 **AND** maxValue > minValue) |
| R05 | Notification (id\_notification, description **NN**, type **NN CK** type **IN** NotificationType, view **NN**, date **NN**, user > User **NN**) |
| R06 | Question (id\_question → Category, name **NN,** title **NN**, description, date **NN DF** Today, votes **NN DF** 0, photo, deleted **NN**, id\_user->User **NN**) |
| R07 | VoteQuestion (username → User, id\_question → Question) |
| R08 | Answer (id\_answer, text **NN**, date **NN DF** Today **CK** Questions.date < date, votes **NN DF** 0, photo, deleted **NN**, id\_question → Question **NN**, user\_post → User **NN**) |
| R09 | VoteAnswer (username → User,id\_answer → Answer) |
| R10 | Comment (firstAnswer → Answer, secondAnswer → Answer) |
| R11 | BestAnswer (id\_bestAnswer → Answer, active **NN**, attributionDate **NN** **CK** Answer.date < attributionDate, text **NN**, date **NN DF** Today **CK** Questions.date < date, votes **NN DF** 0, photo, deleted **NN**) |
| R12 | Faq (id\_faq, question **NN**, answer **NN**) |
| R13 | Report (id\_report, date **NN CK (**Questions.date < date **OR** Answer.date < date), reason **NN**, id\_question → Question, id\_answer → Answer) |
| R14 | UserReport (username → User, id\_report → Report) |
| R15 | Category (id\_category, name **UK NN**) |

*Table 1 - Relational schema.*

## Domains

Below is the specification of useful additional domains:

|  |  |
| --- | --- |
| Today | Date DEFAULT current\_date |
| DateTime | date **CK** ( VALUE > ‘1900-01-01’ AND VALUE <= now() ) |
| DefaultPhoto | String DEFAULT defaultphoto.png |
| NotificationType | Enum (‘question’, ’answer’, ’comment’, ’follow’, ’vote’) |
| RankType | Enum (‘rookie’,’beginner’,’intermediate’,’enthusiast’,’advanced’,’veteran’) |
| RoleType | Enum (‘member’, ’moderator’, ’administrator’) |

*Table 2 - Additional domains.*

## 3. Functional Dependencies and schema validation

In order to validate the Relational Schema obtained from the Conceptual Model, all non-trivial functional dependencies are now identified and the normalization of all relation schemas (altering previously defined relations if necessary) is accomplished in order to achieve a schema in BCNF. A relation is in BCNF if, for all non-trivial functional dependencies, the left side is a super key of the relation.

|  |  |
| --- | --- |
| Table R01 (User) | |
| Keys: {id\_user}, {username}, {email} | |
| Functional Dependencies: | |
| FD0101 | {id\_user} → {username, password, email, bioDescription, birthdate, profilePhoto, banned, deleted, points, id\_rank, id\_role} |
| FD0102 | {username} → {id\_user, password, email, bioDescription, birthdate, profilePhoto, banned, deleted, points, id\_rank, id\_role} |
| FD0103 | {email} → {id\_user, password, email, bioDescription, birthdate, profilePhoto, banned, deleted, points, id\_rank, id\_role} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R02 (Follow) |  |
| Keys: {follower}, {following} |  |
| Functional Dependencies: none |  |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R03 (Role) |  |
| Keys: {id\_role} |  |
| Functional Dependencies: |  |
| FD0301 | {id\_role} → {type, beginningDate, endDate} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R04 (Rank) |  |
| Keys: {id\_rank}, {name} |  |
| Functional Dependencies: |  |
| FD0401 | {id\_rank} → {name, minValue, maxValue} |
| FD0402 | {name} → {id\_rank, minValue, maxValue} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R05 (Notification) |  |
| Keys: {id\_notification} |  |
| Functional Dependencies: |  |
| FD0501 | {id\_notification} → {description, type, view, author} |
| Normal Form: BCNF |  |

|  |  |  |
| --- | --- | --- |
| Table R06 (Question) | |  |
| Keys: {id\_question} | | |
| Functional Dependencies: | |  |
| FD0601 | {id\_question} → {title, description, date, votes, photo, deleted, id\_user, name} | |
| Normal Form: BCNF | |  |

|  |  |
| --- | --- |
| Table R07 (VoteQuestion) |  |
| Keys: {username}, {id\_answer} | |
| Functional Dependencies: none |  |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R08 (Answer) |  |
| Keys: {id\_answer} | |
| Functional Dependencies: |  |
| FD0801 | {id\_answer} → {text, id\_question, date, votes, photo, deleted, username} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R09 (VoteAnswer) |  |
| Keys: {username}, {id\_answer} | |
| Functional Dependencies: none |  |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R10 (Comment) |  |
| Keys: {firstAnswer}, {secondAnswer} | |
| Functional Dependencies: none |  |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R11 (BestAnswer) |  |
| Keys: {id\_bestAnswer} | |
| Functional Dependencies: |  |
| FD1101 | {id\_bestAnswer} → {active, attributionDate, text, date, votes, photo, deleted} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R12 (Faq) |  |
| Keys: {id\_faq}, {question}, {answer} | |
| Functional Dependencies: |  |
| FD1201 | {id\_faq} → {question, answer} |
| FD1202 | {question} → {id\_faq, answer} |
| FD1203 | {answer} → {id\_faq, question} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R13 (Report) |  |
| Keys: {id\_report} | |
| Functional Dependencies: |  |
| FD1301 | {id\_report} → {date,reason, id\_question, id\_answer} |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R14 (UserReport) |  |
| Keys: {username}, {id\_report} | |
| Functional Dependencies: none |  |
| Normal Form: BCNF |  |

|  |  |
| --- | --- |
| Table R15 (Category) |  |
| Keys: {id\_category}, {name} | |
| Functional Dependencies: |  |
| FD1501 | {id\_category} → {name} |
| FD1502 | {name} → {id\_category} |
| Normal Form: BCNF |  |

1. SQL Code

Below is the necessary SQL code to (re)create the database. It can also be found on the project’s page: \database\db.sql

DROP TABLE IF EXISTS "user" CASCADE;

DROP TABLE IF EXISTS follow CASCADE;

DROP TABLE IF EXISTS role CASCADE;

DROP TABLE IF EXISTS rank CASCADE;

DROP TABLE IF EXISTS category CASCADE;

DROP TABLE IF EXISTS question CASCADE;

DROP TABLE IF EXISTS voteQuestion CASCADE;

DROP TABLE IF EXISTS answer CASCADE;

DROP TABLE IF EXISTS voteAnswer CASCADE;

DROP TABLE IF EXISTS comment CASCADE;

DROP TABLE IF EXISTS bestAnswer CASCADE;

DROP TABLE IF EXISTS faq CASCADE;

DROP TABLE IF EXISTS report CASCADE;

DROP TABLE IF EXISTS userReport CASCADE;

DROP TABLE IF EXISTS notification CASCADE;

--Types--

DROP TYPE IF EXISTS notificationType;

CREATE TYPE notificationType AS ENUM ('question', 'answer', 'comment', 'follow', 'vote');

DROP TYPE IF EXISTS rankType;

CREATE TYPE rankType AS ENUM ('rookie', 'beginner', 'intermediate', 'enthusiastic', 'advanced', 'veteran');

DROP TYPE IF EXISTS roleType;

CREATE TYPE roleType AS ENUM ('member','moderator', 'administrator');

--Functions --

DROP FUNCTION IF EXISTS defaultphoto();

CREATE FUNCTION defaultphoto() RETURNS text AS $$

BEGIN

RETURN 'defaultPhoto.png';

END;

$$ LANGUAGE plpgsql;

DROP FUNCTION IF EXISTS categoriequestionDate(id\_category integer);

CREATE FUNCTION categoriequestionDate(id\_category integer) RETURNS date AS $$

BEGIN

RETURN (select "date" From question where id\_category = question.id\_question);

END;

$$ LANGUAGE plpgsql;

DROP FUNCTION IF EXISTS answerDate(id\_answer integer);

CREATE FUNCTION answerDate(id\_answer integer) RETURNS date AS $$

BEGIN

RETURN (select "date" From answer where id\_answer = answer.id\_answer);

END;

$$ LANGUAGE plpgsql;

DROP FUNCTION IF EXISTS reportQuestionDate(id\_question integer,data date);

CREATE FUNCTION reportQuestionDate(id\_question integer,data date) RETURNS boolean AS $$

BEGIN

IF id\_question IS NULL THEN RETURN false;

ELSE

RETURN (select "date" From question where id\_question = question.id\_question)<data;

END IF;

END;

$$ LANGUAGE plpgsql;

DROP FUNCTION IF EXISTS reportAnswerDate(id\_answer integer,data date);

CREATE FUNCTION reportAnswerDate(id\_answer integer,data date) RETURNS boolean AS $$

BEGIN

IF id\_answer IS NULL THEN RETURN false;

ELSE RETURN (select "date" From answer where id\_answer = answer.id\_answer)<data;

END IF;

END;

$$ LANGUAGE plpgsql;

DROP FUNCTION IF EXISTS rookieID();

CREATE FUNCTION rookieID() RETURNS integer AS $$

DECLARE

id integer;

BEGIN

SELECT rank.id\_rank INTO id FROM rank WHERE rank.name = 'rookie';

IF NOT EXISTS id THEN

RAISE EXCEPTION 'A default rank rookie does not exist in the database.';

END IF;

RETURN id;

END;

$$ LANGUAGE plpgsql;

-- DOMAINS--

DROP DOMAIN If EXISTS DateTime;

CREATE DOMAIN DateTime AS date

CONSTRAINT date\_ck CHECK (VALUE > '1900-01-01'::date AND VALUE <=now());

--Tables--

CREATE TABLE role(

id\_role SERIAL PRIMARY KEY,

type roleType NOT NULL DEFAULT 'member',

beginningDate DateTime,

endDate DateTime CONSTRAINT endDateBigger\_ck CHECK (endDate > beginningDate)

);

CREATE TABLE rank (

id\_rank SERIAL PRIMARY KEY,

name rankType NOT NULL DEFAULT 'rookie' CONSTRAINT name\_uk UNIQUE,

minValue integer CONSTRAINT minValue\_ck CHECK (minValue>=0),

maxValue integer CONSTRAINT maxValue\_ck CHECK ((maxValue > 0) AND (maxValue>minValue))

);

CREATE TABLE "user" (

id\_user SERIAL PRIMARY KEY,

username text NOT NULL CONSTRAINT username\_uk UNIQUE,

password text NOT NULL,

email text NOT NULL CONSTRAINT email\_uk UNIQUE,

bioDescription text,

birthdate DateTime NOT NULL,

profilePhoto text DEFAULT defaultPhoto(),

points integer NOT NULL CONSTRAINT points\_ck CHECK (points >= 0),

id\_rank integer NOT NULL DEFAULT rookieID() REFERENCES rank (id\_rank) ON UPDATE CASCADE,

banned boolean NOT NULL,

deleted boolean NOT NULL,

id\_role integer NOT NULL REFERENCES role (id\_role) ON UPDATE CASCADE

);

CREATE TABLE follow (

follower integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE,

following integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE,

PRIMARY KEY(follower,following)

);

CREATE TABLE notification (

id\_notification SERIAL PRIMARY KEY,

description text NOT NULL,

type notificationType NOT NULL,

view boolean NOT NULL,

"date" DateTime NOT NULL,

id\_user integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE

);

CREATE TABLE category(

id\_category SERIAL PRIMARY KEY,

name text NOT NULL CONSTRAINT categoryname\_uk UNIQUE

);

CREATE TABLE question(

id\_question integer PRIMARY KEY NOT NULL REFERENCES category (id\_category) ON UPDATE CASCADE ON DELETE CASCADE,

name text NOT NULL,

title text NOT NULL,

description text,

"date" DateTime NOT NULL DEFAULT now(),

votes integer NOT NULL DEFAULT 0,

photo text,

deleted boolean NOT NULL,

id\_user integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE

);

CREATE TABLE voteQuestion(

username integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE,

id\_question integer NOT NULL REFERENCES question (id\_question) ON UPDATE CASCADE,

PRIMARY KEY (username,id\_question)

);

CREATE TABLE answer(

id\_answer SERIAL PRIMARY KEY,

"text" text NOT NULL,

"date" DateTime NOT NULL DEFAULT now() CONSTRAINT date\_ck CHECK (categoriequestionDate(id\_answer) < "date"),

votes integer NOT NULL DEFAULT 0,

photo text,

deleted boolean NOT NULL,

id\_question integer NOT NULL REFERENCES question (id\_question),

user\_post integer NOT NULL REFERENCES "user" (id\_user)

);

CREATE TABLE voteAnswer(

username integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE,

id\_answer integer NOT NULL REFERENCES answer (id\_answer) ON UPDATE CASCADE,

PRIMARY KEY (username,id\_answer)

);

CREATE TABLE comment(

firstAnswer integer NOT NULL REFERENCES answer (id\_answer) ON UPDATE CASCADE,

secondAnswer integer NOT NULL REFERENCES answer (id\_answer) ON UPDATE CASCADE,

PRIMARY KEY (firstAnswer,secondAnswer)

);

CREATE TABLE bestAnswer (

id\_bestAnswer integer PRIMARY KEY REFERENCES answer (id\_answer) ON UPDATE CASCADE ON DELETE CASCADE,

attributionDate DateTime NOT NULL CONSTRAINT attributionDate\_ck CHECK (answerDate(id\_bestAnswer) < attributionDate),

"text" text NOT NULL,

"date" DateTime NOT NULL DEFAULT now() CONSTRAINT date\_ck CHECK (categoriequestionDate(id\_bestAnswer) < "date"),

deleted boolean NOT NULL,

active boolean NOT NULL,

votes integer NOT NULL DEFAULT 0,

photo text

);

CREATE TABLE faq(

id\_faq SERIAL PRIMARY KEY,

question text NOT NULL CONSTRAINT question\_uk UNIQUE,

answer text NOT NULL CONSTRAINT answer\_uk UNIQUE

);

CREATE TABLE report(

id\_report SERIAL PRIMARY KEY,

"date" DateTime NOT NULL CONSTRAINT reportDate\_ck CHECK (reportQuestionDate(id\_question,"date") = true OR reportAnswerDate(id\_answer,"date") = true),

reason text NOT NULL,

id\_question integer REFERENCES question (id\_question),

id\_answer integer REFERENCES answer (id\_answer)

);

CREATE TABLE userReport(

username integer NOT NULL REFERENCES "user" (id\_user) ON UPDATE CASCADE,

id\_report integer NOT NULL REFERENCES report (id\_report) ON UPDATE CASCADE,

PRIMARY KEY (username,id\_report)

);

## REVISION HISTORY

Changes made to the first submission:

1. We added a new domain to restrict dates: DateTime.
2. We have eliminated some decompositions by correcting the primary keys in User table and Question table.

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