**A5 – Relational schema, validation and schema refinement**

This artifact contains the relational schema obtained by mapping the conceptual data model made in the previous week, which allows a different approach of the entities and relationship involved in a project management web application.

1. **Relational Schema**

The relational schema includes the relational schema attributes, domains, keys (primary and foreign) and other integrity rules.

|  |  |
| --- | --- |
| R01 | User (id, e-mail NN UK, full\_name, password NN, URL NN UK, username NN UK, administrator NN DF 0, user\_ban→User) |
| R02 | Project (id, description, end\_date **CK** end\_date > start\_date, name **NN**, privacy **DF** privacy=0, start\_date **NN DF** today, state **NN CK** state **IN** stateType **DF** ’In\_progress’, id\_coordinator NN→ User, user\_archived→User) |
| R03 | Board (id, description, name **NN**, id\_creator NN→ User, id\_project NN→ Project) |
| R04 | Task (id, budget, deadline **NN**, description, name **NN**, progress **CK** 0 ≤ progress ≤ 100, state **NN CK** state **IN** stateType **DF** ’In\_progress’, id\_creator NN→ User, id\_board NN→ Board) |
| R05 | Meeting (id, date **NN CK** date > today, name, place, id\_board NN→ Board) |
| R06 | Personal\_event (id, date **NN CK** date > today, name, place, id\_user NN→ User) |
| R07 | Comment (id, comment **NN**, date **NN DF** today, id\_user NN→ User, id\_task NN→ Task) |
| R08 | File (id, description, path **NN**, publish\_date **NN DF** today, id\_user NN→ User, id\_task NN→ Task) |
| R09 | Notification (id, date **NN DF** today, notification **NN**, read **NN DF** 0, id\_user NN→ User) |
| R10 | Progress\_update (id, date **NN DF** today, new\_value **CK** 0 ≤ new\_value ≤ 100, id\_user NN→ User, id\_task NN→ Task) |
| R11 | Message (id, date **NN DF** today, message **NN**, id\_user NN→ User, id\_project NN→ Project) |
| R12 | Project\_team (id\_project NN→ Project, id\_worker NN→ User) |
| R13 | Board\_team (id\_board NN→ Board, id\_worker NN→ User) |
| R14 | Profile\_picture (id\_image NN, id\_user NN→ User, path **UK**) |
| R15 | Project\_picture (id\_image NN, id\_project NN→ Project, path **UK**) |
| R16 | Contact (id\_user NN→ User, id\_contact NN→ User) |

Relational schemas are presented above, where UK means UNIQUE KEY, NN means NOT NULL, DF means DEFAULT and CK means CHECK.

1. **Domains**

Specification of additional domains:

|  |  |
| --- | --- |
| today | DATE DEFAULT CURRENT\_DATE |
| stateType | ENUM (‘Closed’, ‘In\_progress’, ‘Archived’) |

1. **Functional dependencies and 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:** {id},{e-mail}, {URL}, {username} | |
| **Functional Dependencies** | |
| FD0101 | {id} → {e-mail, full\_name, password, URL, username, administrator, user\_ban} |
| FD0102 | {e-mail} → {id, full\_name, password, URL, username, administrator, user\_ban} |
| FD0103 | {URL} → {id, e-mail, full\_name, password, username, administrator, user\_ban} |
| FD0104 | {username } → {id, e-mail, full\_name, password, URL, administrator, user\_ban} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R02** (Project) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0201 | {id} → {description, end\_date, name, privacy, start\_date, state, id\_coordinator} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R03** (Board) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0301 | {id} → {description, name, id\_creator, id\_project} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R04** (Task) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0401 | {id} → {budget, deadline, description, name, progress, state, id\_creator, id\_board} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R05** (Meeting) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0501 | {id} → {date, name, place, id\_board} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R06** (Personal\_event) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0601 | {id} → {date, name, place, id\_user} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R07** (Comment) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0701 | {id} → {comment, date, id\_user, id\_task} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R08** (File) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD0801 | {id} → {description, path, publish\_date, id\_user, id\_task} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R09** (Notification) | |
| **Keys:** {id, id\_user} | |
| **Functional Dependencies** | |
| FD0901 | {id, id\_user} → {date, notification, state} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R10** (Progress\_update) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD1001 | {id} → {date, new\_value, id\_user, id\_task} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R11** (Message) | |
| **Keys:** {id} | |
| **Functional Dependencies** | |
| FD1101 | {id} → {date, message, id\_user, id\_project} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R12** (Project\_team) | |
| **Keys:** {id\_project, id\_worker} | |
| **Functional Dependencies** | |
| (none) | |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R13** (Board\_team) | |
| **Keys:** {id\_board, id\_worker} | |
| **Functional Dependencies** | |
| (none) | |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R14** (Profile\_picture) | |
| **Keys:** {id\_image, path} | |
| **Functional Dependencies** | |
| FD1401 | id\_image → {id\_user, path} |
| FD1402 | path → {id\_image, id\_user} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R15** (Project\_picture) | |
| **Keys:** {id\_image, path} | |
| **Functional Dependencies** | |
| FD1501 | id\_image → {id\_project, path} |
| FD1502 | path → {id\_image, id\_project} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R16** (Contact) | |
| **Keys:** {id\_user, id\_contact} | |
| **Functional Dependencies** | |
| (none) | |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R17** (Ban\_user) | |
| **Keys:** {id\_user} | |
| **Functional Dependencies** | |
| FD1701 | id\_user → {id\_administrator} |
| **NORMAL FORM** | BCNF |

|  |  |
| --- | --- |
| **Table R18** (Archive\_project) | |
| **Keys:** {id\_project} | |
| **Functional Dependencies** | |
| FD1801 | id\_project → {id\_administrator} |
| **NORMAL FORM** | BCNF |

All relations schemas are in the Boyce-Codd Normal Form, so the relational schema is also in the BCNF and there is no need to be refined using normalization.

1. **SQL Code**

(<https://github.com/TeresaValerio/LBAW1734/blob/master/Artefactos/A5/database.sql>)

|  |
| --- |
| -- |
|  | -- Tables |
|  | -- |
|  | CREATE TABLE "Archive\_project" ( |
|  | id\_administrator integer NOT NULL, |
|  | id\_project integer NOT NULL, |
|  | date timestamp without time zone DEFAULT now() NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Ban\_user" ( |
|  | id\_user integer NOT NULL, |
|  | id\_administrator integer NOT NULL, |
|  | date timestamp without time zone DEFAULT now() NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Board" ( |
|  | id integer NOT NULL, |
|  | description text, |
|  | name text NOT NULL, |
|  | id\_creator integer NOT NULL, |
|  | id\_project integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Board\_team" ( |
|  | id\_board integer NOT NULL, |
|  | id\_user integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Comment" ( |
|  | id integer NOT NULL, |
|  | comment text NOT NULL, |
|  | date timestamp without time zone DEFAULT now() NOT NULL, |
|  | id\_user integer NOT NULL, |
|  | id\_task integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Contact" ( |
|  | id\_user integer NOT NULL, |
|  | id\_contact integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "File" ( |
|  | id integer NOT NULL, |
|  | path text NOT NULL, |
|  | publish\_date timestamp without time zone DEFAULT now() NOT NULL, |
|  | description text, |
|  | id\_user integer NOT NULL, |
|  | id\_task integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Meeting" ( |
|  | id integer NOT NULL, |
|  | date timestamp without time zone NOT NULL, |
|  | name text, |
|  | place text, |
|  | id\_board integer NOT NULL, |
|  | CONSTRAINT "CK1" CHECK ((date > now())) |
|  | ); |
|  |  |
|  | CREATE TABLE "Message" ( |
|  | id integer NOT NULL, |
|  | message text NOT NULL, |
|  | date timestamp without time zone DEFAULT now() NOT NULL, |
|  | id\_user integer NOT NULL, |
|  | id\_project integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Notification" ( |
|  | id integer NOT NULL, |
|  | id\_user integer NOT NULL, |
|  | date timestamp without time zone DEFAULT now() NOT NULL, |
|  | notification text NOT NULL, |
|  | read boolean DEFAULT false NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Personal\_event" ( |
|  | id integer NOT NULL, |
|  | date timestamp without time zone NOT NULL, |
|  | place text, |
|  | name text, |
|  | id\_user integer NOT NULL, |
|  | CONSTRAINT "CK1" CHECK ((date > now())) |
|  | ); |
|  |  |
|  | CREATE TABLE "Profile\_picture" ( |
|  | id integer NOT NULL, |
|  | id\_user integer NOT NULL, |
|  | path text NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Progress\_update" ( |
|  | id integer NOT NULL, |
|  | date timestamp without time zone DEFAULT now() NOT NULL, |
|  | new\_value integer NOT NULL, |
|  | id\_user integer NOT NULL, |
|  | id\_task integer NOT NULL, |
|  | CONSTRAINT "CK1" CHECK ((new\_value > 0)), |
|  | CONSTRAINT "CK2" CHECK ((new\_value <= 100)) |
|  | ); |
|  |  |
|  | CREATE TABLE "Project" ( |
|  | id integer NOT NULL, |
|  | description text, |
|  | start\_date timestamp without time zone DEFAULT now() NOT NULL, |
|  | end\_date date, |
|  | name text NOT NULL, |
|  | id\_coordinator integer NOT NULL, |
|  | state text DEFAULT 'In\_progress' NOT NULL, |
|  | privacy boolean DEFAULT false NOT NULL, |
|  | CONSTRAINT "CK1" CHECK ((end\_date > start\_date)), |
|  | CONSTRAINT "CK2" CHECK ((state = ANY (ARRAY['In\_progress'::text, 'Closed'::text, 'Archived'::text]))) |
|  | ); |
|  |  |
|  | CREATE TABLE "Project\_picture" ( |
|  | id integer NOT NULL, |
|  | id\_project integer NOT NULL, |
|  | path text NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Project\_team" ( |
|  | id\_user integer NOT NULL, |
|  | id\_project integer NOT NULL |
|  | ); |
|  |  |
|  | CREATE TABLE "Task" ( |
|  | id integer NOT NULL, |
|  | budget money, |
|  | deadline date NOT NULL, |
|  | description text, |
|  | name text NOT NULL, |
|  | progress integer DEFAULT 0 NOT NULL, |
|  | state text DEFAULT 'In\_progress' NOT NULL, |
|  | id\_creator integer NOT NULL, |
|  | id\_board integer NOT NULL, |
|  | CONSTRAINT "CK1" CHECK ((progress > 0)), |
|  | CONSTRAINT "CK2" CHECK ((progress <= 100)), |
|  | CONSTRAINT "CK3" CHECK ((state = ANY (ARRAY['In\_progress'::text, 'Closed'::text, 'Archived'::text]))) |
|  | ); |
|  |  |
|  | CREATE TABLE "User" ( |
|  | id integer NOT NULL, |
|  | "e-mail" text NOT NULL, |
|  | full\_name text, |
|  | password text NOT NULL, |
|  | "URL" text NOT NULL, |
|  | username text NOT NULL, |
|  | administrator boolean DEFAULT false NOT NULL |
|  | ); |
|  |  |
|  | -- |
|  | -- Primary Keys and Uniques |
|  | -- |
|  | ALTER TABLE ONLY "Archive\_project" |
|  | ADD CONSTRAINT "Archive\_project\_pkey" PRIMARY KEY (id\_administrator); |
|  |  |
|  | ALTER TABLE ONLY "Ban\_user" |
|  | ADD CONSTRAINT "Ban\_user\_pkey" PRIMARY KEY (id\_user); |
|  |  |
|  | ALTER TABLE ONLY "Board" |
|  | ADD CONSTRAINT "Board\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Board\_team" |
|  | ADD CONSTRAINT "Board\_team\_pkey" PRIMARY KEY (id\_board, id\_user); |
|  |  |
|  | ALTER TABLE ONLY "Comment" |
|  | ADD CONSTRAINT "Comment\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Contact" |
|  | ADD CONSTRAINT "Contact\_pkey" PRIMARY KEY (id\_user, id\_contact); |
|  |  |
|  | ALTER TABLE ONLY "File" |
|  | ADD CONSTRAINT "File\_path\_key" UNIQUE (path); |
|  |  |
|  | ALTER TABLE ONLY "File" |
|  | ADD CONSTRAINT "File\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Meeting" |
|  | ADD CONSTRAINT "Meeting\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Message" |
|  | ADD CONSTRAINT "Message\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Notification" |
|  | ADD CONSTRAINT "Notification\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Personal\_event" |
|  | ADD CONSTRAINT "Personal\_event\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Profile\_picture" |
|  | ADD CONSTRAINT "Profile\_picture\_path\_key" UNIQUE (path); |
|  |  |
|  | ALTER TABLE ONLY "Profile\_picture" |
|  | ADD CONSTRAINT "Profile\_picture\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Progress\_update" |
|  | ADD CONSTRAINT "Progress\_update\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Project\_picture" |
|  | ADD CONSTRAINT "Project\_picture\_path\_key" UNIQUE (path); |
|  |  |
|  | ALTER TABLE ONLY "Project\_picture" |
|  | ADD CONSTRAINT "Project\_picture\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Project" |
|  | ADD CONSTRAINT "Project\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "Project\_team" |
|  | ADD CONSTRAINT "Project\_team\_pkey" PRIMARY KEY (id\_user, id\_project); |
|  |  |
|  | ALTER TABLE ONLY "Task" |
|  | ADD CONSTRAINT "Task\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "User" |
|  | ADD CONSTRAINT "User\_URL\_key" UNIQUE ("URL"); |
|  |  |
|  | ALTER TABLE ONLY "User" |
|  | ADD CONSTRAINT "User\_e-mail\_key" UNIQUE ("e-mail"); |
|  |  |
|  | ALTER TABLE ONLY "User" |
|  | ADD CONSTRAINT "User\_pkey" PRIMARY KEY (id); |
|  |  |
|  | ALTER TABLE ONLY "User" |
|  | ADD CONSTRAINT "User\_username\_key" UNIQUE (username); |
|  |  |
|  | -- |
|  | -- Foreign Keys |
|  | -- |
|  | ALTER TABLE ONLY "Archive\_project" |
|  | ADD CONSTRAINT "Archive\_project\_id\_administrator\_fkey" FOREIGN KEY (id\_administrator) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Archive\_project" |
|  | ADD CONSTRAINT "Archive\_project\_id\_project\_fkey" FOREIGN KEY (id\_project) REFERENCES "Project"(id); |
|  |  |
|  | ALTER TABLE ONLY "Ban\_user" |
|  | ADD CONSTRAINT "Ban\_user\_id\_administrator\_fkey" FOREIGN KEY (id\_administrator) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Ban\_user" |
|  | ADD CONSTRAINT "Ban\_user\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Board" |
|  | ADD CONSTRAINT "Board\_id\_creator\_fkey" FOREIGN KEY (id\_creator) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Board" |
|  | ADD CONSTRAINT "Board\_id\_project\_fkey" FOREIGN KEY (id\_project) REFERENCES "Project"(id); |
|  |  |
|  | ALTER TABLE ONLY "Board\_team" |
|  | ADD CONSTRAINT "Board\_team\_id\_board\_fkey" FOREIGN KEY (id\_board) REFERENCES "Board"(id); |
|  |  |
|  | ALTER TABLE ONLY "Board\_team" |
|  | ADD CONSTRAINT "Board\_team\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Comment" |
|  | ADD CONSTRAINT "Comment\_id\_task\_fkey" FOREIGN KEY (id\_task) REFERENCES "Task"(id); |
|  |  |
|  | ALTER TABLE ONLY "Comment" |
|  | ADD CONSTRAINT "Comment\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Contact" |
|  | ADD CONSTRAINT "Contact\_id\_contact\_fkey" FOREIGN KEY (id\_contact) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Contact" |
|  | ADD CONSTRAINT "Contact\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "File" |
|  | ADD CONSTRAINT "File\_id\_task\_fkey" FOREIGN KEY (id\_task) REFERENCES "Task"(id); |
|  |  |
|  | ALTER TABLE ONLY "File" |
|  | ADD CONSTRAINT "File\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Meeting" |
|  | ADD CONSTRAINT "Meeting\_id\_board\_fkey" FOREIGN KEY (id\_board) REFERENCES "Board"(id); |
|  |  |
|  | ALTER TABLE ONLY "Message" |
|  | ADD CONSTRAINT "Message\_id\_project\_fkey" FOREIGN KEY (id\_project) REFERENCES "Project"(id); |
|  |  |
|  | ALTER TABLE ONLY "Message" |
|  | ADD CONSTRAINT "Message\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Notification" |
|  | ADD CONSTRAINT "Notification\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Personal\_event" |
|  | ADD CONSTRAINT "Personal\_event\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Profile\_picture" |
|  | ADD CONSTRAINT "Profile\_picture\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Progress\_update" |
|  | ADD CONSTRAINT "Progress\_update\_id\_task\_fkey" FOREIGN KEY (id\_task) REFERENCES "Task"(id); |
|  |  |
|  | ALTER TABLE ONLY "Progress\_update" |
|  | ADD CONSTRAINT "Progress\_update\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Project" |
|  | ADD CONSTRAINT "Project\_id\_coordinator\_fkey" FOREIGN KEY (id\_coordinator) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Project\_picture" |
|  | ADD CONSTRAINT "Project\_picture\_id\_project\_fkey" FOREIGN KEY (id\_project) REFERENCES "Project"(id); |
|  |  |
|  | ALTER TABLE ONLY "Project\_team" |
|  | ADD CONSTRAINT "Project\_team\_id\_project\_fkey" FOREIGN KEY (id\_project) REFERENCES "Project"(id); |
|  |  |
|  | ALTER TABLE ONLY "Project\_team" |
|  | ADD CONSTRAINT "Project\_team\_id\_user\_fkey" FOREIGN KEY (id\_user) REFERENCES "User"(id); |
|  |  |
|  | ALTER TABLE ONLY "Task" |
|  | ADD CONSTRAINT "Task\_id\_board\_fkey" FOREIGN KEY (id\_board) REFERENCES "Board"(id); |
|  |  |
|  | ALTER TABLE ONLY "Task" |
|  | ADD CONSTRAINT "Task\_id\_creator\_fkey" FOREIGN KEY (id\_creator) REFERENCES "User"(id); |

Changes made to the first submission:

1. Added NN for foreign keys where restriction was missing;
2. Deleted Archive\_project and Ban\_user relations;
3. Added user as foreign key of user (to represent the user that banned him) and project (to represent the user that archived that project);
4. Added keys and functional dependencies for “User”;
5. Added kay “path” and functional dependency for “Profile\_picture” and “Project\_picture”;
6. Moved BCNF justification to after the tables (previously was in the beginning);

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