NUS

National University of Singapore

CS2102

Project 1

Team 109

Team Members:

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List of Constraints:

1) Projects can be almost anything
2) Users are either creator or backer or both
3) User may have up to 2 Credit Cards and each must have at least one
4) 2 projects can have same name and created by same creator
5) Only one creator per project
6) No projects that are not created by a creator
7) Many backers for each project
8) Backer may not fund any project or can back multiple projects at the same time
9) Each backer can fund the same project only once
10) Unique reward level within the same project
11) User can back the reward level with higher amount but not less than stated value
12) User can fund only through reward level and only fund one level in a particular project
13) Creator can announce one update at a single time (time + date)
14) Backers request for refund within 90 days of project deadline
15) Employee approves/rejects a refund request
16) If approved, record date of acceptance and if rejected, record date of rejection
17) User is not charged if the funding did not meet goal (no refund request can be made)
18) When refund is pending, there may not be an associated employee
19) Each user can request for refund only once
20) If rejected request, no other request can be made for that project
21) Employees verify users but not all need to be verified
22) User verified by at most one employee

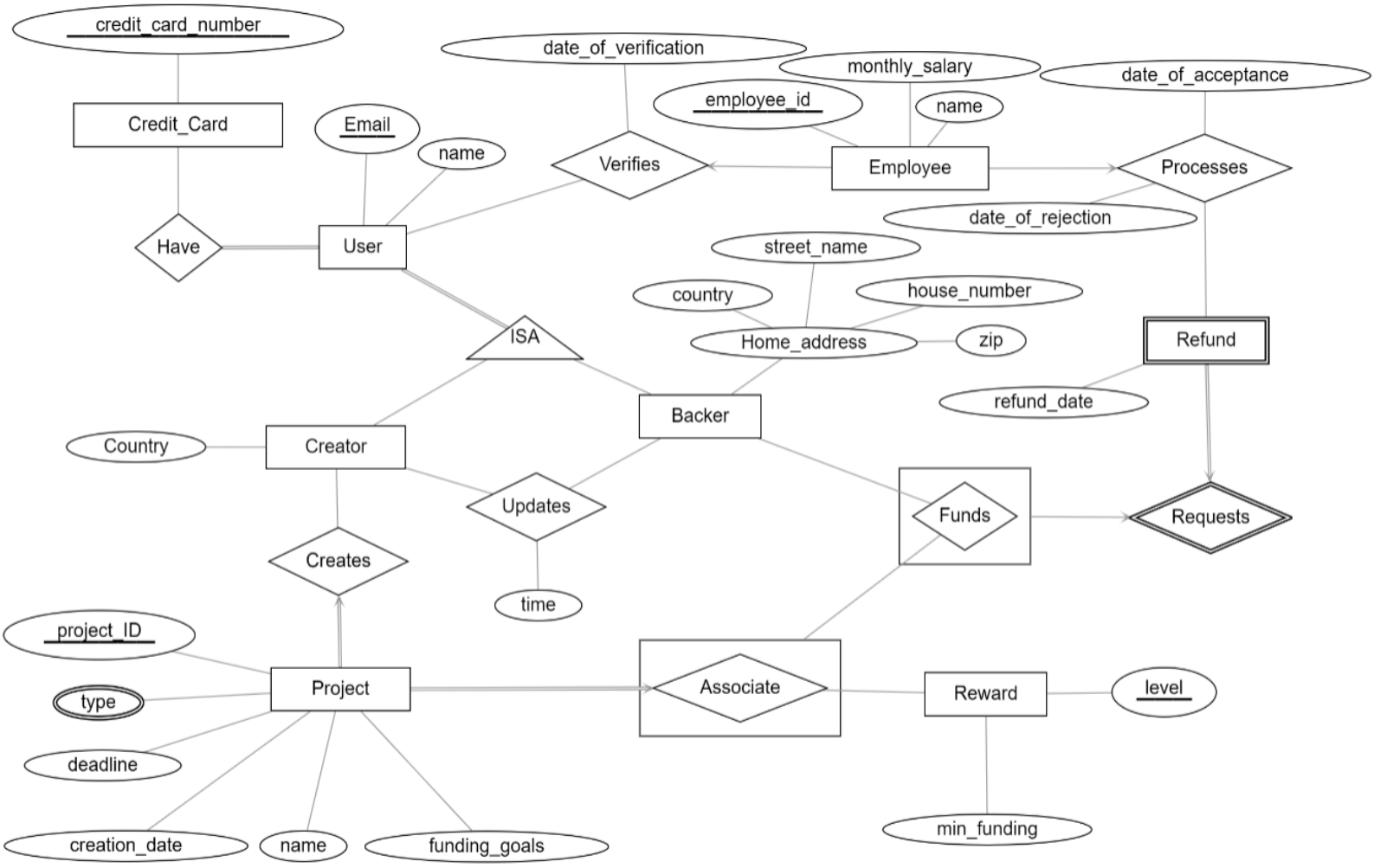
Assumptions and Justifications for design decisions

1. Projects can be almost anything, can have more than 1 category or have no categories, so we put "type" as a multivalued attribute under the [Project] entity.
2. Because each project is said to be associated with a reward level, each reward level is said to record minimum amount of money for funding and a user can only fund a project using the reward level, so we make the whole relation [Project]-<Associate>-[Reward] to be an aggregation, and then this [Project-Associate-Reward] have relation <Funds> to [Backer]. In the end, it is [[Project]-<Associate>-[Reward]]-<Funds>-[Backer]
3. For each funding that a backer made, they can request for a refund. Because a refund request requires data like backer's id, the funding project's id, we decided to make <Funds> to be an aggregation [<Funds>] so that we can make use of data from this aggregation later for the design of refund requests. Since a refund request can only exist

when the backer made a funding, we decided to make Refund to be a weak entity set of [Backer]

4. An user is said to be either creator or backer and must specify whether they want to be a creator or backer or both, so we decided to use ISA hierarchy with both covering and overlap constraints.
5. An user is said to have at least one and up to two credit cards. Taking into consideration that in reality, maybe a credit card can be used by more than one user (family members use/borrow another one card), we decided to make the relation <Has> between [User] and [CreditCard] to be a many-to-many relation with full participation constraint from [User]. The upper bound constraint "up to two credit cards" will be covered in relational by having 2 attributes "cc_number1" and "cc_number2" schema.

ER Model



Constraints not captured by the ER

1. For Constraint 3: A user may have up to 2 Credit Cards and each must have at least one. However, the ER diagram does not indicate the maximum limit of 2 and instead uses the total participation constraint of at least one shown between user and credit_card entity
2. For Constraint 9: Each backer can fund the same project only once which cannot be implemented above as it would add further restrictions to the relation between backer and project, disapproving the constraint 8
3. For Constraint 11: User can back the reward level with higher amount but not less than the stated value but this cannot be shown in the diagram comparing the amounts
4. For Constraint 14: Backers request for refund within 90 days of project deadline but since comparison cannot be indicated above, it cannot be implemented in ER Model
5. For Constraint 18: When refund is pending, there may not be an associated employee but since the status of pending cannot be reflected in ER, this statement cannot be justified completely

Relational Schema

```
DROP TABLE IF EXISTS Employee,CreditCard, User,Creator,BackerReward,
Project,Updates,Verifies,Processes,Associate,Funds,Refund CASCADE;

/* Relational schema*/

CREATE TABLE Employee (
  employee_id SERIAL PRIMARY KEY,
  name TEXT,
  monthly_salary NUMERIC
);

CREATE TABLE CreditCard (
  credit_card_number INTEGER,
  PRIMARY KEY(credit_card_number),
);

CREATE TABLE User (
  email VARCHAR(200) PRIMARY KEY,
  name TEXT,
  cc_number1 VARCHAR(20) NOT NULL,
  cc_number2 VARCHAR(20),
```

```
  FOREIGN KEY cc_number1 REFERENCES CreditCard(credit_card_number),
  FOREIGN KEY cc_number2 REFERENCES CreditCard(credit_card_number)
);

CREATE TABLE Creator (
  country TEXT,
  email VARCHAR(200),
  PRIMARY KEY (email),
  FOREIGN KEY email REFERENCES User(email) ON DELETE CASCADE
);

CREATE TABLE Backer (
  street_name TEXT,
  house_number VARCHAR(20),
  country TEXT,
  zip INTEGER,
  email VARCHAR(200),
  PRIMARY KEY (email),
  FOREIGN KEY email REFERENCES User(email) ON DELETE CASCADE
);

CREATE TABLE Reward (
  level VARCHAR(20) PRIMARY KEY,
  min_funding NUMERIC
);

CREATE TABLE Project (
  project_id SERIAL PRIMARY KEY,
  name TEXT,
  deadline VARCHAR(20),
  funding_goals NUMERIC,
  creation_date DATE,
  type TEXT,
  c_email VARCHAR(200),
  rlevel TEXT,
  PRIMARY KEY(project_id,level),
  FOREIGN KEY c_email NOT NULL REFERENCES Creator(email),
  FOREIGN KEY rlevel REFERENCES Reward(level)
);
```

```
CREATE TABLE Updates (
  time TIMESTAMP,
  u1_email VARCHAR(200),
  u2_email VARCHAR(200),
  PRIMARY KEY(u1_email,u2_email,time),
  FOREIGN KEY u1_email REFERENCES Creator(email),
  FOREIGN KEY u2_email REFERENCES Backer(email)
);

CREATE TABLE Verifies(
  date_of_verification DATE,
  e_id SERIAL,
  u_email VARCHAR(200),
  PRIMARY KEY (e_id),
  FOREIGN KEY e_id REFERENCES Employee(employee_id),
  FOREIGN KEY u_email REFERENCES User(u_email)
);

CREATE TABLE Processes (
  date_of_rejection DATE,
  date_of_acceptance DATE,
  e_id SERIAL,
  PRIMARY KEY (e_id),
  FOREIGN KEY e_id REFERENCES Employee(employee_id)
);

CREATE TABLE Associate (
  p_id SERIAL,
  rlevel TEXT,
  PRIMARY KEY (p_id,rlevel),
  FOREIGN KEY p_id REFERENCES Project(project_id),
  FOREIGN KEY rlevel REFERENCES Reward(level),
);

CREATE TABLE Funds (
  p_id SERIAL,
  rlevel TEXT,
  u_email VARCHAR(200),
  PRIMARY KEY (p_id,rlevel,u_email),
  FOREIGN KEY (p_id,rlevel) REFERENCES Associate(p_id,rlevel),
```

```
  FOREIGN KEY u_email REFERENCES Backer(email)
);

CREATE TABLE Refund (
  refund_date DATE,
  p_id SERIAL,
  rlevel TEXT,
  u_email VARCHAR(200),
  PRIMARY KEY(p_id,rlevel,u_email),
 FOREIGN KEY (p_id,rlevel,u_email) REFERENCES Funds(p_id,rlevel,u_email) ON DELETE
CASCADE
);
```

Constraints not captured by the Relational Schema

1. For Constraint 1: The composite attribute ‘type’ under Project entity couldn’t be represented in the schema to portray that project can be almost anything.
2. For Constraint 11: User can back the reward level with higher amount but not less than stated value couldn’t be implemented completely as minimum funding cannot be referenced across other tables above
3. For Constraint 17: If funding goal is not met, there can be no refund request is partially shown using the ON DELETE CASCADE condition, with regard to the weak entity set but is yet not directly shown for the funding goals specifically.
4. For Constraint 20: Once rejected request, no request allowed again is also not implemented the schema above since the link between rejection and request cannot be directly shown above
5. For Constraint 2: The relational schema shows that user can be backer or creator but does not show the case when user is both

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Project 2

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Team Members:

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1. Project Responsibilities

Name	Contribution
Hoang Huu Chinh	- Created the dummy data file - Worked on Triggers 2,5,6, Procedure 3, Function 3
Gupta Ananya Vikas	- Worked on Trigger 1,3, Procedure 1 & 2, Function 2
Tan Jing Xue Andre	- Worked on drafting the report - Worked on Triggers 1, 3
Phua Anson	- Worked on Triggers 3,4, Function 1& 3

The project responsibilities were evenly distributed. We coded the triggers, functions and procedures separately, divided evenly among every member and then we came together to debug and show the logic behind our coded functions, procedures and triggers, followed by giving feedback to each other and fixing the routines with broken logic. Next, each of us tested on the other's routines to ensure that they are compiling and working with some test cases and edge cases suggested.

Files included in the zip file: DDL.sql (Schema file), data.sql (dummy data file), Proc.sql (functions, procedures and triggers)

2. Triggers

Trigger 1: To enforce the constraint that Users === {Creators, Backers}

Trigger Name: check_user_type

Function name: check_user()

Description:

This trigger checks that a user must either be a backer, creator or both. This is reinforced through the function check_user and a series of if-else statements to determine its kind. So first, the user would be checked against the records in the Creators table and then Backers table where the declared variable 'assigned' would be updated each time. The user (identified through his unique email) is first checked from the Creators' pool then subsequently, from the Backers'. If the assigned quantity remains 0, it indicates an invalid user type and that entry is deleted as it is not a user belonging to either of the tables. An exception is raised to indicate the violation and a null value is returned.

Given that the function needs to verify the user, it is deferrable in nature and therefore, called AFTER INSERT ON since the user is added to the User table and checked after the constraint is initially deferred.

Trigger 2: To enforce the constraint that a backer's pledge amount should minimally be greater or equal to the reward level

Trigger Name: trigger2

Function name: trigger2_func()

Description:

This trigger guarantees a backer's pledge is only verified if it meets the required reward level. The numeric min is first recorded. It then captures a reward's minimum amount and through an if-else statement, a new reward ID and name will only be updated if that user's min input is greater or equal to the reward level. Otherwise, a null output is returned to indicate a rejection.

Trigger 3: To enforce that each project must have at least one reward level

Trigger Name: reject_adding_project

Function name: do_not_add_project()

Description:

The function enforces that a project must have one reward level at minimum. We first declare a counter to tally the reward levels.

Should the counter have at least 1 level, we return the new ID of the reward. Otherwise, we return a null with a warning that the input project does not have any reward level.

The trigger used BEFORE INSERT as we wish to execute this trigger first to check if the conditions are met before we insert the accepted ID in.

Trigger 4: Enforce the constraint that refunds can only be approved if refunds are requested within 90 days of the deadline and that refunds not requested cannot be approved or rejected.

Trigger Name: process_refund

Function name: processing_the_refund

Description:

The function initially declares two date features; “request_date” determines if a refund is requested (it stores the attribute “requests” from Backs) and “project_deadline” captures the date of deadline from the entity Projects. A successful refund updates the primary key ID of Project, the refund’s email and back’s pid.

The validation comes in 2 if-else statement, the first checks if the request_date is null, if so, there is no request and null is return, otherwise a refund is requested. Within another nested if-else loop, this statement now checks if the requested time

exceeds the Project's deadline attribute by 90, if so we will return the new tuple but indicate a "false" to signify that this refund is not approved. Otherwise, we follow through with the request.

The trigger uses BEFORE INSERT again as we wish to execute this trigger to check whether a request is successful before inserting the new approved/unapproved tuple.

Trigger 5: Enforce the constraint that backers back before deadline

Trigger Name: trigger5

Function name: trigger5_func()

Description:

We declare 2 date features: created_date (which captures the Project's date created attribute) and deadline_date (captures the deadline attribute of the same Project).

We store any update from the Project primary Key onto the new output "NEW.id".

Through an if-else statement, we will check if a backer's requested date has exceeded the existing deadline, or if a new requested date happens before the date of any project created. If so, we return a NULL value. Otherwise, we will make the update accordingly.

This trigger runs on BEFORE INSERT, before we do an insertion, we have to verify the constraint that a backer cannot back after a deadline nor back before any project is even created.

Trigger 6: Enforces the constraint that refunds can only be made for successful projects

Trigger Name: trigger6

Function name: trigger6_func

Description:

Declaring 2 numeric: “total”, “goal” features ; 1 date: “deadline” feature

In “total”, we use the aggregate function SUM() to tally up the refund value (specifically the numeric attribute amount in Backs)

In “goal” and “deadline” we store their respective attributes from the Project entity.

In an if-else statement, we verify if a request date is valid by first checking the refund date has passed the deadline. Concurrently, we also check if our input refund value exceeds or equals to that project’s goal value. If both conditions are met, we will update an existing New.id back into a pre-existing projects.id. Otherwise, we return a null to indicate an unsuccessful refund.

This trigger runs on BEFORE UPDATE as no insertions are made, but instead, we wish to fire the trigger to check if refunds can be made possible before we update the project ID.

3. Procedures

Procedure 1: Adding new user which is a creator, backer or both

Name: add_user

Description:
This function uses a nested if-else statement where first the given attributes for the new user are checked if the 'kind' of user is amongst the three possible values: BACKER, CREATOR, BOTH and if it belongs to one of them then it is added in the Users table. Within this IF statement, there is an individual check done for each of the kinds to add them to their respective tables Backer or Creator or added in both accordingly. Thai ensures that no invalid user is added in any table.

Procedure 2: Adding a new project with their reward level

Name: add_project

Description:

Our procedure initially states all required attributes and their data types. An INT holder labeled 'n' is declared which will store the length of the arrays of the names of the project.

We continue if this length 'n' is more than 0 (indicating a project exists) where we will add into Projects the new id, email, ptype (Project type), created (date of creation), name, the project's deadline and goal and then add the first element of the arrays of names and minimum amounts given for the new project id into Rewards table to prevent foreign key constraint being violated.

Following this, the function uses a loop to traverse through the arrays of names and minimum amounts given for the project id from index 2. Within the loop, we will then insert into the Rewards table the name, id and pledge amount extracted from the arrays, until all n elements of reward levels for the project id are added.

Procedure 3: A procedure to help an employee with id ‘eid’ auto-reject all refund request made 90 days from the project’s deadline

Name: auto_reject

Description:

The procedure declares 2 feature data type, ‘eid’ (INT) for the employee’s ID and ‘today’ (DATE) for today’s date

We start with an UPDATE Statement as our aim is to modify existing entries in the Refunds table.

The SET Command next updates our date attribute to today and the accepted is updated as FALSE to signify a rejected request.

From the Refunds and Projects Table, we search for Projects with Refunds via their primary key (email) along with its Employee ID (eid).

We then specify the condition that a rejected request would be one whose time exceeds the project’s deadline by 90 days (Refunds.date – Projects.deadline > 90) as auto_failed (its Employer ID is also captured here).

The WHERE STATEMENT next will then filter the requests as rejected if they satisfy this condition.

4. Functions

Function 1: Write a function to find the emails and names of all superbackers for a given month and year

Name: find_superbackers

Description:

The function initially declares some datatypes, 2 Integer datatype counters for projects and types (successful_project_count, successful_project_type_counter), Booleans criterions A and B for for conditions and a cursor.

Our function utilizes this cursor to loop through the backers' email to check if each backer fulfills Condition A or B as stated. Should a backer not be verified by either conditions, then they will be assigned 'Not superbackers' to their name (Where name <> 'Not superbacker').

Function 2: Find the find the top N most successful project's ID, name,email of creator and the amount pledged based on a success metric for given date

Name: find_top_success

Description: This function returns the result as a table with the attributes ID , name , email , amount captured from the Projects table. To derive the success metric: the funding ratio, the aggregate function is used on the backer's pledge amount before dividing it by the project goal.

A WHERE Clause then filters based on our project type , it's id and a GROUP BY statement is used to group rows according to the ID. An ORDER BY keyword helps sort our attribute funding_ratio first then deadline and ID in a descending order to ensure we obtain only the most successful projects first

To ensure we obtain the most successful projects in a descending order, an ORDER BY keyword helps sort our attribute funding_ratio first then deadline and it's ID in that manner. Finally the LIMIT Clause is used to specify the number of records to return.

Function 3: Write a function to find the project's ID and name, the email of the creator and number of days it takes for the project to reach its funding goal, for the top N most popular projects based on the popularity metric for the given date.

Name: find_top_popular

Description:
In our main function : find_top_popular, we aim to return a table of different Projects with their attribute ID, name, Creator's Email and the number of days to reach the funding. We first execute the selection through the SELECT DISTINCT Statement to select required keys from their respective tables. To select the DAYS feature, we call onto a predetermined function (num_of_days_to_reach_goal). The ORDER BY… ASC Keyword then sorts every project DAYS and ID to implement the popularity metric. Finally we call the LIMIT Clause to restrict the number of returns to the top N and call another ORDER…BY DESC to sort our results table in a descending order

Function 4: subordinate function used with find_top_popular

Name: num_of_days_to_reach_goal

Description:
This function works to give the number of days to reach a goal by checking through each record in the Backs table using a cursor. First, the goal, progress, cursor and record are declared, which are updated as we loop along every record. The project goals are extracted separately into variable 'goal', which then checks for popularity within the cursor to return the number of days to reach the goal compared to the funding amount which is recorded under 'progress' variable.

5. Reflection

The experience of conducting this project was quite enriching and made us appreciate the content taught in class. The relation between a constraint and its implication while coding the triggers was something we explored thoroughly in this project. In terms of the routines, we did a lot of discussion and trial and error on how to enforce each trigger and the logic enforced in each function. Following that, we carried out several tests using the data file we created and kept trying different edge cases to ensure that each routine worked in the required manner, which highlighted new problems and we would have to fix the functions based on any failed case to check how to enforce the additional constraint or if we are missing a particular constraint. Overall, it was a lot of back and forth to finally conclude with a function that would cover as many cases as possible.

One of the challenges was that while creating a test data file, it was difficult to incorporate every kind of case so we had to take some time to manually populate the data file with each row to ensure every constraint is satisfied. Considering these cases and changing the routines in several iterations was surely challenging and made the time allocated for this project quite intensive into debugging and redefining our implementations.

In terms of group work, we split the project routines amongst ourselves. We split the routines in a way that every person had 4-5 routines to work on independently. Hence, when we discussed our logic and approaches, so that we can debug faster and clarify the logic of the routines better. Once, we discussed the entire code in our weekly meetings, we tested each other's functions and triggers for more thorough testing. It made sure that we had weekly meetings to keep up with our assigned work and make sure we are moving in the right direction for the next meeting.

Overall, we feel that this project has given us a good understanding of the fundamental concepts and implementation of them, which can be applied in future projects.