KØBENHAVNS UNIVERSITET

Mandatory assignment 1

Gruppe 16

DIS

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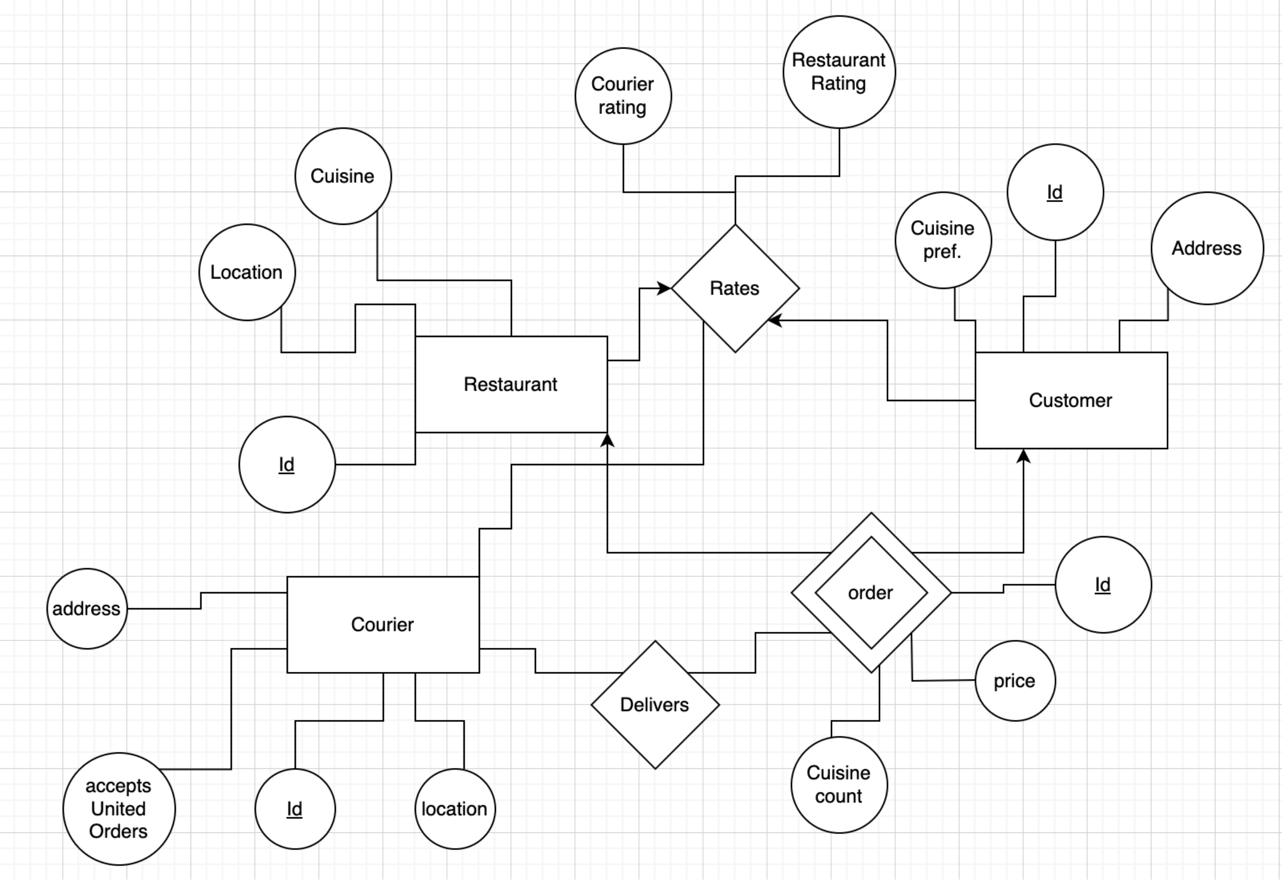
Gruppemedlemmer

Navn	KUid
Victoria Schønnemann	drb639
Emil V. Ramsbæk	Tdh424
Mikkel Dollerup	ndt926

Exercise 1 - Volt United

a) Design a high-level E/R model



b) Discuss your modeling choices.

Our E/R diagram consist of 3 entities. Restaurant, Courier and Customer. Each entity is connected by a relation. The restaurant entity has following attributes: Id, Location and cuisine. Restaurant has a relation to ”Rates”which stores Courier and Restaurant rating.
Our customer entity has attributes: Cuisine preference, Id(primary key) and address. Customer links to the ”Rates”relation which store their restaurant rating. The ”order”relation has a weak relation to Customer since there can't exist orders without any customers. Every order has a unique id as the primary key.
The courier entity has attribute Id(primary key), a bool value stating whether they accept Volt united orders or not and a location attribute. The order relationship has Id attribute as primary key and a price attribute.
We have added a unique primary key to all entities making them unique.

c) Translate your E/R model to the relational model.

```
-- Restaurant Table
CREATE TABLE Restaurant (
  ID INT PRIMARY KEY,
  Location VARCHAR(30),
  Cuisine VARCHAR(20)
);

-- Courier Table
CREATE TABLE Courier (
  ID INT PRIMARY KEY,
  Accepts_Volt_United BOOLEAN,
  Location VARCHAR(30)
);

-- Customer Table
CREATE TABLE Customer (
  ID INT PRIMARY KEY,
  Cuisine_Preference VARCHAR(20),
  Address VARCHAR(30)
);

-- Rates Table
CREATE TABLE Rates (
  Customer_ID INT,
  Restaurant_ID INT,
  Rating INT,
  FOREIGN KEY (Customer_ID) REFERENCES Customer(ID) ON DELETE CASCADE,
  FOREIGN KEY (Restaurant_ID) REFERENCES Restaurant(ID) ON DELETE CASCADE
);

-- Order Table
CREATE TABLE Orders (
  ID INT PRIMARY KEY,
  Customer_ID INT,
  Price DECIMAL(10, 2),
  FOREIGN KEY (Customer_ID) REFERENCES Customer(ID) ON DELETE CASCADE
);
```

d) Create a schema and one example instance in the format accepted by RC-EVAL

Here is the schemas in the format accepted by RC-eval

Restaurant(id: int, location: string, cuisine: string)
Courier(id: int, location: string, address: string, accepts_united_orders: boolean)
Costumer(id: int, address: string, cuisine preference: string)
Order(id: int, price: int, cuisine_count: int, costumer_id: int, restaurant_id: int, delivers: boolean)
Delivers(courier_id: int, order_id: int)
Rates(courier_rating: int, restaurant_rating: int)

Furthermore, we have created an example instance in the format accepted by RC-EVAL

Restaurant(1, A, ”Italian”)
Courier(2, B, X, true)
Costumer(3, C, ”Chinese”)
Order(4, 75, 2, 875, 2255, false)
Delivers(00345, 835793)
Rates(87, 100)

e) Formulas of Relational Calculus for Querying

(i)

$$\{(o.\text{Id}) \mid \text{Orders}(o) \wedge o.\text{Customer\_Id} = c.\text{Id} \wedge c.\text{Address} = \text{”customer\_address}\}$$

(ii)

$$\{(r.\text{Id}) \mid \text{Restaurant}(r) \wedge \text{Rates}(c.\text{Id}, r.\text{Id}, \text{poor\_rating}) \wedge \text{Rates}(c.\text{Id}, r.\text{Id}, \text{favorite\_tag})\}$$

(iii)

$$\{(co.\text{Id}) \mid \text{Courier}(co) \wedge \text{Rates}(c.\text{Id}, r.\text{Id}, \text{poor\_rating}) \wedge \text{Rates}(r.\text{Id}, co.\text{Id}, \text{favorite\_tag})\}$$

(iv)

$\{(c.\text{Id}) \mid \text{Customer}(c) \wedge \forall o \in \text{Orders}, r \in \text{Restaurant}, co \in \text{Courier} : (o.\text{Id} = \text{order\_id} \wedge o.\text{Customer\_Id} = c.\text{Id} \wedge \text{Rates}(c.\text{Id}, r.$

Exercise 2 - Relational Calculus

a) What PC models have a ram of 512 MB?

EXISTS type. PC(model, speed , ram, hd, price) AND ram = 512

b) Which manufacturers make laptops with a screen size of 15?

EXISTS type. Product(maker:string, model:int, type) AND type = Laptop AND Laptop(model:int, speed:int, ram:int, hd:int, screen, price:int) AND screen = 15

c) Find the model number and price of all products (of any type) made by manufacturer E.

EXISTS maker, type, speed, ram, hd, screen.
Product(”E”, model, type)
AND
Laptop(model, speed, ram, hd, screen, price)
OR
EXISTS maker, type, speed, ram, hd, screen.
Product(”E”, model, type)
AND
PC(model, speed, ram, hd, price)
OR
EXISTS maker, type1, type2, color, type.
Product(”E”, model, type1)
AND
Printer(model, color, type2, price)

d) Find the makers, model numbers, and prices of all offered devices.

EXISTS type, speed, ram, hd, screen. Product(maker, model, type)
AND
Laptop(model, speed, ram, hd, screen, price)
OR
EXISTS, type, speed, ram, hd, screen. Product(maker, model, type)
AND
PC(model, speed, ram, hd, price)
OR
EXISTS, type, color, ram, hd, screen. Product(maker, model, type)
AND
Printer(model, color, type, price)

e) Find the model numbers of all color laser printers that are not made by manufacturer E.

EXISTS color, price. Product(maker, model, ”printer”) AND NOT maker = ”E”

f) Find those manufacturers that sell PCs, but not Printers. Do not rely on the correctness of the ”type”column in Product for this query.

EXISTS model, speed, ram, hd, price.
PC(model, speed, ram, hd, price)
AND
Product(maker, model, ”pc”)
AND NOT EXISTS model_p, color, type, price_p.
Printer(model_p, color, type, price_p)
AND
Product(maker, model_p, ”printer”)

g) Find those screen sizes that occur in two or more laptops.

EXISTS model1, model2, screen1, ram1, ram2, price1, price2, hd1, hd2, speed1, speed2.
Laptop(model1, speed1, ram1, hd1, screen1, price1)
AND
Laptop(model2, speed2, ram2, hd2, screen2, price2)
AND(screen1 = screen2 AND NOT model1 = model2)

h) Find the manufacturers of Laptops with at least three different hard disk sizes.

EXISTS hd1, hd2, hd3.
(EXISTS model, speed, ram, hd, screen, price. Product(maker, model, type) AND Laptop(model, speed, ram, hd1, screen, price))
AND
(EXISTS model, speed, ram, hd, screen, price. Product(maker, model, type) AND Laptop(model, speed, ram, hd2, screen, price))
AND
(EXISTS model, speed, ram, hd, screen, price. Product(maker, model, type) AND Laptop(model, speed, ram, hd3, screen, price))
AND NOT hd1 = hd2
AND NOT hd2 = hd3
AND NOT hd1 = hd3

i)Find the manufacturers who sell exactly three different Printer models

EXISTS model1, model2, model3.
(EXISTS color, type1, type2, price. Product(maker, model1, type1) AND Printer(model1, color, type2, price))
AND
(EXISTS color, type1, type2, price. Product(maker, model2, type1) AND Printer(model2, color, type2, price))
AND
(EXISTS color, type1, type2, price. Product(maker, model3, type1) AND Printer(model3, color, type2, price))
AND NOT model1 = model2
AND NOT model2 = model3
AND NOT model1 = model3

j)

EXISTS model. EXISTS color. EXISTS type. EXISTS price.
Product(maker, model, ”printer”) AND Printer(model, color, type, price)

k)

FORALL maker, model, type.
((Product(maker, model, type) AND EXISTS speed, ram, hd, price. PC(model, speed, ram, hd,

price)) IMPLIES (type = ”pc”))
AND
((Product(maker, model, type) AND EXISTS speed, ram, hd, screen, price. Laptop(model, speed, ram, hd, screen, price)) IMPLIES (type = ”laptop”))
AND
((Product(maker, model, type) AND EXISTS color, type, price. Printer(model, color, type, price)) IMPLIES (type = ”printer”))