Algorithms and datastructures Exercises

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6.1 Indicate the following according to figure 1.

acctNo	type	balance
12345	savings	12000
23456	checking	1000
34567	savings	25

The relation **Accounts**

firstName	lastName	idNo	account
Robbie	Banks	901-222	12345
Lena	Hand	805-333	12345
Lena	Hand	805-333	23456

The relation **Customers**

Figure 1: Two relations of a banking database

6.1.a The attributes of each realtion

Accounts: $acctNo, type, balance$
Customers: $firstName, lastName, idNo, account$

6.1.b The tuples of each realtion

- $12345, savings, 12000$

- $23456, checking, 1000$

- $34567, savings, 25$

- *Robbie, Banks, 901 − 222, 12345*

- *Lena, Hand, 805 − 333, 12345*

- *Lena, Hand, 805 − 333, 23456*

6.1.c   The components of one tuble of each realtion

12000
Banks

6.1.d   The relation schema of each realtion

$Accounts(acctNo, type, balance)$
$Customers(firstName, lastName, idNo, account)$

6.1.e   The database schema

$Accounts, Customers$

6.1.f   A suitable domain of each attribute

- $acctNo$ - INT

- $type$ - $VARCHAR[20]$

- $balance$ - INT

- $firstName$ - $VARCHAR[20]$

- $lastName$ - $VARCHAR[20]$

- $idNo$ - $CHAR[7]$

- $account$ - INT

6.1.g   Another equivalent way to present each relation.

The attributes could simply just be in a different order.

6.2 In a table with the following attributes which are valid example of keys

$$title, year, length, genre, studioName, producerC\#$$

- title, year

- title, year, studioName

- title, length

- length, genre, studioName, year

6.3 How many ways can relation be represented if it has:

6.3.a Four attributes and five tuples

$4! \cdot 5! = 2880$

6.3.b n attributes and m tuples

$n! \cdot m!$

6.4 Write a database schema of the following relations

The datasbase schema includes
$Product(make, model, type)$
$PC(model, speed, ramhd, price)$
$Laptop(model, speed, ram, hd, screen, price)$
$Printer(model, color, type, price)$

6.4.a Write a schema for $Product$

CREATE TABLE Product(VARCHAR[20] maker, INT model, INT type)
The type is here an int where 0 is PC, 1 is laptop and 2 is printer. There is
no foreign keys due to it being the lookup table for the other relations

6.4.b Write a schema for PC

CREATE TABLE PC(INT model, FLOAT speed, INT ram, BOOLEAN hd,
FLOAT prize, FOREIGN KEY(Products) REFERENCES Products(model))
Here the model is a reference to products, speed is gigahertz of CPU

6.4.c Write a schema for *Printer*

CREATE TABLE Printer(INT model, BOOLEAN color, VARCHAR[20] type, FLOAT price, FOREIGN KEY(Products) REFERENCES Products(model))

6.4.d Write an alternation for Printer and delete the attribute color

ALTER TABKE Printer DROP color

6.4.e Add an *od* attribute for PC, which defaults to none an otherwise can be cd or dvd

ALTER TABLE PC ADD VARCHAR[20] od DEFAULT 'none'

7 Uge

7.1 Working with linear notation

The following exercises uses the following schema:
$Product(maker, model, type)$
$PC(model, speed, ram, hd, price)$
$Laptop(model, speed, ram, hd, screen, price)$
$Printer(model, color, type, price)$

7.1.a PC models which have speed of at least 3.00?

$\pi_{model}(\sigma_{speed>3.00}(PC))$

7.1.b PC manufacturers which makes PC with a hdd with at leat 100GB

$\pi_{maker}(Product \bowtie \sigma_{hd>=100}(PC))$

7.1.c Find model and price of all products made by manufacturer B

$$man := \sigma_{maker=B}(Product)$$
$$PCModelPrice := \pi_{model,price}(man \bowtie PC)$$
$$LaptopModelPrice := \pi_{model,price}(man \bowtie Laptop)$$
$$PrinterModelPrice := \pi_{model,price}(man \bowtie Printer)$$
$$modPrice := PCModelPrice \cup LaptopModelPrice \cup PrinterModelPrice$$

7.1.d Find model numbers of all color laster printers

$$\pi_{model}(Product \bowtie \sigma_{color=1ANDtype=laser}(Printer))$$

7.1.e Find manufactures that sell Laptops but not PC

Due to algebra not including a method for group by I have answered in form of SQL queries.
SELECT (SELECT maker FROM LAPTOP NATURAL JOIN Product GROUP BY maker) - (SELECT maker FROM PC NATURAL JOIN Product GROUP BY maker)

7.1.f Find hd size which accour in two or more PC's

$$PC = \pi_{model,hd}(PC)$$
$$PC2(model2, hd) = \pi_{model,hd}(PC)$$
$$hd = \pi_{hd}(\sigma_{model!=model}(PC \bowtie PC2)$$

7.2 In the following data, what is the result of $\pi_{speed}(PC)$ when treated as a bag and set

model	speed	ram	hd	price
1001	2.66	1024	250	2114
1002	2.10	512	250	995
1003	1.42	512	80	478
1004	2.80	1024	250	649
1005	3.20	512	250	630
1006	3.20	1024	320	1049
1007	2.20	1024	200	510
1008	2.20	2048	250	770
1009	2.00	1024	250	650
1010	2.80	2048	300	770
1011	1.86	2048	160	959
1012	2.80	1024	160	649
1013	3.06	512	80	529

Bag

speed
2.66
2.10
1.42
2.80
3.20
3.20
2.20
2.20
2.00
2.80
1.86
2.80
3.06

Set

speed
2.66
2.10
1.42
2.80
3.20
2.20
2.00
2.80
1.86
3.06

8 Week

8.1 What are the expexted FD's in the following database and what key would it have

- name

- Social Security number

- street address

- city

- state

- ZIP code

- area code

- phone number

Social Security number $\rightarrow$ name,street address, city, state, ZIP code, area code
phone number $\rightarrow$ name key: Social security number, phone number

8.2 Consider the relation with schema $R(A, B, C, D)$ and FD's $AB \rightarrow C, C \rightarrow D, D \rightarrow A$

8.2.a What are all the nontrivial FD's that follow from the given FD's? You should restrict yourself to FD's with single attributes on the rigth side

$AB \rightarrow C$
$C \rightarrow D$
$D \rightarrow A$
ABD
$C \rightarrow A$

8.2.b What are all the keys of R

$AB^+ = \{C, D\}$
$C^+ = \{A, D\}$
$D^+ = \{A\}$
$BC^+ = \{D, A\}$

$BD^+ = \{A, C\}$
AB, BC, DC

8.2.c   What are all the superkeys for R that is not keys?

BC, BD

8.3   Find BCNF violations and decompose the schema

8.3.a $R(A, B, C, D)$ with $AB \to C$, $C \to D$, and $D \to A$

$AB^+ = \{C, D, A\}$ - violation.
$R1 = R - AB^+ + AB = R(A, B)$
$R2 = AB^+ = R2(A, C, D)$

8.3.b $R(A, B, C, D, E)$ and $AB \to C, DE \to C, B \to D$

Starts wit the original relation
$R(A, B, C, D, E)$
The table violates ABC
$AB^+ = \{C, D\}$
$R1 = R - AB^+ = R(A, B, E)$
$R2 = AB^+ + AB = R(A, B, C, D)$
But $R2$ violates $B \to D$
$B^+ = \{D\}$
$R3 = R2 - B^+ = R(A, B, C)$
$R4 = B^+ + B = R(B, D)$
Therefore the new realtions are $R1, R3, R4$, since none now violates BCNF.

8.4   Perform the chase method on the relations $R(A, B, C), R(B, C, D), R$ using the given FD's

8.4.a $B \to E$ and $CE \to A$

A, B, C, D_1, E_1
A_2, B, C, D, E_2
A, B_3, C, D_3, E
$E_1 = E_2$ - $B \to E$
$A_2 = A$ - $CE_1 \to A$
$E_1 = E$ - $CE \to A$
Therfore on line two is now
A, B, C, D, E

8.4.b $A \rightarrow D, D \rightarrow E$ **and** $B \rightarrow D$

A, B, C, D_1, E_1
A_2, B, C, D, E_2
A, B_3, C, D_3, E
$D_1 = D$ - $B \rightarrow D$
$A_2 = A$ - $A \rightarrow D$
$D_3 = D$ - $A \rightarrow D$
$E_1 = E$ - $D \rightarrow E$

8.5 The following exercise is on the relation $Courses(C, T, H, R, S, G)$

The relation has the following FD's
$C \rightarrow T$
$HR \rightarrow C$
$HT \rightarrow R$
$HS \rightarrow R$
$CS \rightarrow G$

8.5.a What are all the keys for $Courses$

The candidate keys are:
$CSH^+ = \{T, G, R\}$
$SHR^+ = \{C, T, G\}$

8.5.b Verify that the given FD's are their own minimal basis

$C^+ = \{T\}$
$HR^+ = \{C, T\}$
$HT^+ = \{R, C\}$
$HS^+ = \{R, C, T\}$
$CS^+ = \{G, T\}$
As it can be seen no one of the FD's closure result in another FD, therefore making it minimal.

8.5.c Make the relation into a 3NF and check if any BCNF violation accour

$R1(C, T)$
$R2(H, R, C, T)$
$R3(H, T, R, C)$
$R4(H, S, R, C, T)$

$R5(C, S, G, T)$
$R2$ violates BCNF due to $HT \rightarrow R$, the same with $R3$ due to HR FD.

9 Week

9.1 Create a ER diagram from the given information
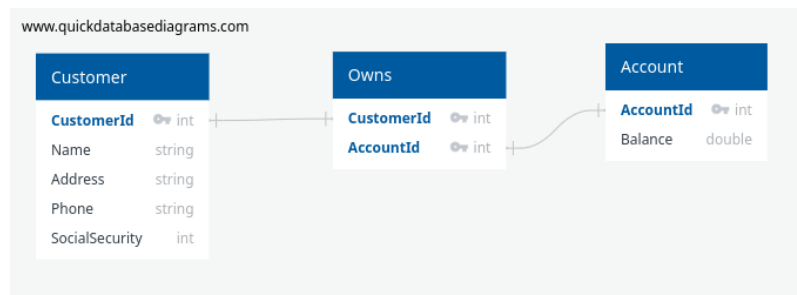
Figure 2: ER diagram describing a bank scenario

9.2 Create a ER diagram from the given information
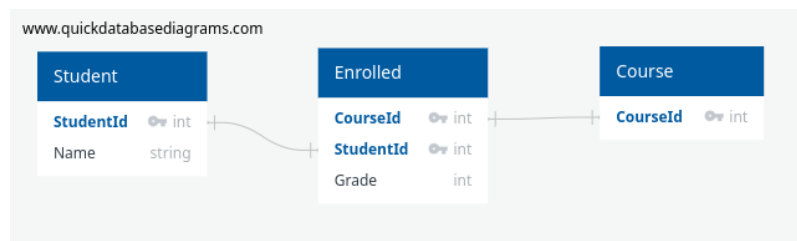
Figure 3: ER diagram describing a course and student enrollment

9.3 Create a ER diagram from the given information

9.4 Create a relation schema from the given diagram

Customer(SSNO primary,phone,addr,name)
Flights(number primary,day primary, aircraft)
Bookings(SSNo primary, number primary, day primary, row, seat)

Figure 4: ER diagram describing a department and course situation with a weak key

9.5 Create a relation using the different methods, from the given diagram

9.5.a Straigt E/R model

Courses(room,number primary)
Depts(name primary, chair)
GivenBy(number primary, name primary)
LabCourses(number primary, computerAllo)

9.5.b The object oriented

The same as Depts, GivenBy and Courses but...
LavCourses(number primary, room, CcomputerAllo)

9.5.c The null method
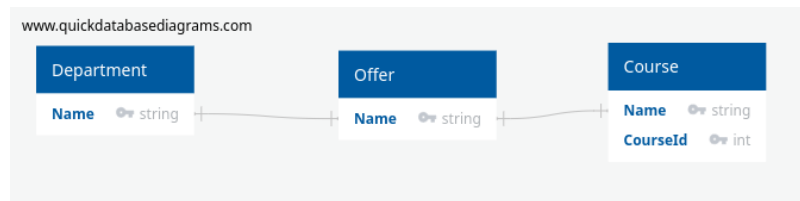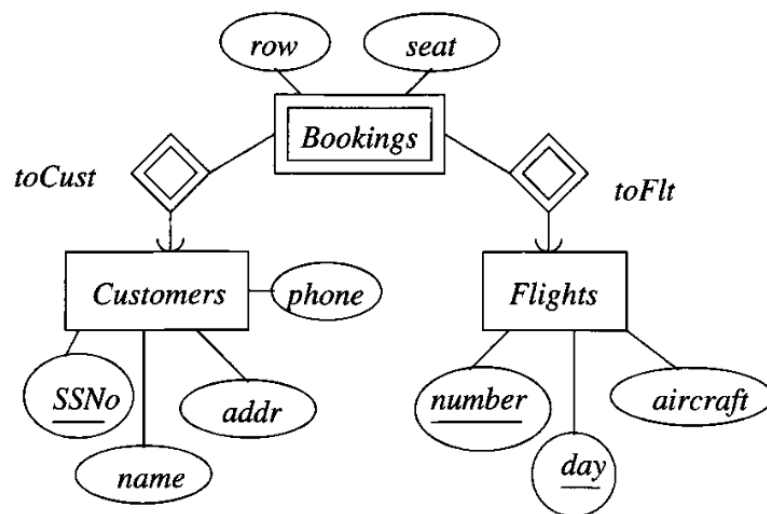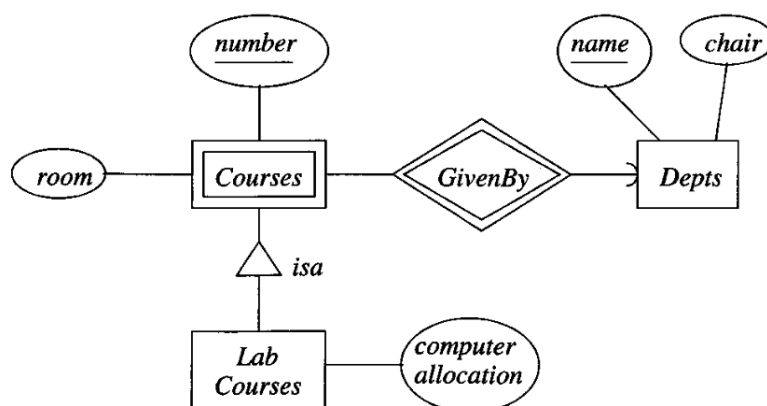
The same Depts and Given by but...
LabCourses(number primary, room, computerAllo)

10 Week

Create the following functions in Java The functions are used on:
Product(maker, model, type)
PC(model, speed, ram, hd, price)

10.0.a Given speed and RAM, find PC's model number

```java
import java.sql.*;

Class.forName("org.postgresql.Driver"); //For postsql envirement
String url = "jdbc:postgresql://" + host + "[:" + port + "]/" + databa
Connection myCon = DriverManager.getConnection(URL, username, password

public static ArrayList<String> findModel(int speed, int ram) {
        Statement stat = myCon.createStatement("SELECT model FROM PC W
        ResultSet res = stat.executeQuery();
        ArrayList<String> models = new ArrayList<>();
        while(res.next())
                models.add(res.getString(0));
        return models;
}
```

10.0.b   Given a model number, remove the tuble

```java
public static void removeModel(String model) {
        Statement stat = myCon.createStatement();
        stat.executeUpdate("REMOVE FROM PC WHERE model ='" +model+"'");
        Statement stat2 = myCon.createStatement();
        stat2.executeUpdate("REMOVE FROM Products WHERE model ='" +mod
        myCon.commit();
}
```

10.0.c   Decrease price of PC to 100 given mode

```java
public static void updatePrice(String model) {
        Statement stat = myCon.createStatement();
        stat.executeUpdate("UPDATE PC SET price=100 WHERE model ='" +m
        myCon.commit();
}
```

10.0.d   Given all info for a PC check if model number exist if not insert

```java
public static void tryInsert(String model, int speed, int ram, int hd,
        Statement stat = myCon.createStatement("SELECT model FROM PC W
        ResultSet res = stat.executeQuery();
        if(res != null) {
                System.out.println("Model already exist");
                return
        }
        Statement stat = myCon.createStatement();
        stat.executeUpdate("INSERT INTO PC VALUES('"+model+"',"+speed+
        myCon.commit();
}
```

10.0.e   Ask the for a price and print maker, model and speed of PC

```java
import java.util.Scanner;
Scanner sc = new Scanner(System.in);

public static void closestPrice() {
```

```
                System.out.println("Wanted_price?");
                int wantedPrice = sc.nextInt();
                int closestPrice = 0;
                String closestModel;
                Statement stat = myCon.createStatement("SELECT_price,_model_FRO
                ResultSet res = stat.executeQuery();
                while(res.next()) {
                        int price = res.getInt(0);
                        if(Math.abs(wantedPrice - closestPrice) > Math.abs(wan
                                closestPrice = price;
                                model = res.getString(1);
                        }
                }
                Statement stat2 = myCon.createStatement("SELECT_maker_FROM_Pro
                String maker = stat2.executeQuery().getString(0);
                System.out.println("The_closest_PC_to_the_price_is:_"+ model +
}
```

10.0.f Ask for minimum speed,RAM, hdd and screen, and print all compatible laptops plus maker

```
public static void findLaptop() {
                System.out.println("Wanted_speed,_RAM,_hdd_size_and_screen_siz
                int speed = sc.nextInt();
                int ram = sc.nextInt();
                int hdd = sc.nextInt();
                int screen = sc.nextInt();
                Statement stat = myCon.createStatement("SELECT_*_FROM_PC");
                ResultSet res = stat.executeQuery();
                while(res.next()) {
                        int PCSpeed = res.getInt(1);
                        int PCRam = res.getInt(2);
                        int PCHd = res.getInt(3);
                        int PCScreen = rest.getInt(4);
                        if(PCSpeed > speed && PCRam > ram && PCHd > hdd && PCS
                                String model = rest.getString(0);
                                Statement stat2 = myCon.createStatement("SELEC
                                String maker = stat2.executeQuery().getString(
                                System.out.println("The_model:_"+model+"_by_"+
                        }
```

```
        }
}
```

10.1   Write OSN procedues for the following tasks

MovieStar(name, address, gender, birtdate)
MovieExec(name, address, cert#, netWorth)
Studio(name, address, presC#)

10.1.a   Given name of a movie studio return net worth of president

CREATE PROCEDURE netWorth(IN studio CHAR(15), OUT worth INT)
DECLARE foundWorth INTEGER; BEGIN SET worth = 0; set foundWorth
= SELECT netWorth FROM MovieExec WHERE cert = (SELECT presC
FROM Studio WHERE name = studio); SET worth = worth + foundWorth;
END;

10.1.b   Given name and address, return 1 if movie star, 2 if executive producer, 3 if non, 4 if both

CREATE PROCEDURE title(IN n CHAR(15),IN a CHAR(15), OUT INT)
DECLARE star INTEGER; DECARE prod INTEGER; BEGIN SET star =
SELECT COUNT(name) FROM MovieStar WHERE name = n AND address = a; SET prod = SELECT COUNT(name) FROM MovieExec WHERE
name = n AND address = a; IF(1 ¡= star AND 1¡= prod) return 4; ELSEIF
(1 ¡= star) return 1; ELSEIF (1 ¡= prod) return 2; ELSE return 3; END IF;
END;