Algorithms and datastructures
Exercises

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2022

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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

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

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

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

7.1.g Find PC models which have the same speed and RAM, a pair should only be listed once

$$
\begin{aligned}
Model1 &= \pi_{model,speed,RAM}(PC) \\
Model2(model2, speed, RAM) &= \pi_{model,speed,RAM}(PC) \\
models &= \pi_{model,model2}(\sigma_{model!=model2}(PC \bowtie PC2)
\end{aligned}
$$

7.1.h Find PC models which have the same speed and RAM, a pair should only be listed once

$$ModelPC = \pi_{model}\sigma_{speed>=2.8}(PC)$$
$$ModelLaptop = \pi_{model}\sigma_{speed>=2.8}(Laptop)$$
$$models = ModelPC \cup ModelLaptop$$
$$mans = \pi_{maker,model}(models \bowtie Product)$$
$$twoProduct = \sigma_{maker2=makerandmodel2!=model}(\rho_{maker2,model2}mans \times mans)$$

7.1.i Find manufactore(s) of the fastest PC or laptop

$$computers = \pi_{model,speed}Laptop \cup PC$$
$$computers2(model2, speed2) = computers$$
$$slowSpeed = \pi_{speed}(computers \bowtie_{speed<speed2} computers2)$$
$$fastSpeed(fast) = \pi_{speed}(computers) - slowSpeed$$
$$fastModels = computers \bowtie_{speed=fast} fastSpeed$$
$$mans = \pi_{maker}(fastModels \bowtie Product)$$

7.1.j Find manufactores who sellf at lest three PC's

$$model = \rho_{model}PC$$
$$computers = model \times model(model2) \times model(model3)$$
$$models = \sigma_{model=model2andmodel2=model3}(computers)$$
$$mans = \pi_{maker}(models \bowtie Product)$$

7.1.k Find manufactores who sell atleast 3 different speed PC's

$$model = \rho_{model}PC$$
$$computers = model \times model(model2) \times model(model3)$$
$$models = \sigma_{model=model2andmodel2=model3}(computers)$$
$$mans = \pi_{maker}((models \bowtie Product)$$

7.1.l Find manufactores who sell exactly three PC's

$$model = \rho_{model} PC$$
$$computers = model \times model(model2) \times model(model3)$$
$$models = \sigma_{model=model2 and model2=model3}(computers)$$
$$TooManycomputers = model \times model(model2) \times model(model3) \times model(model4)$$
$$models = \sigma_{model=model2 and model2=model3}(computers)$$
$$TooManymodels = \sigma_{model=model2 and model2=model3 and model3=model4}(computers)$$
$$mans = \pi_{maker}((models \bowtie Product)$$

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 In the query SELECT A B is b an attribute or alias

B will be an alias for it to be an attribute A and B has to be comma seperated.

8.2 Write the following queries based on the following tables

Movies(title , year, length, genre, studioName, producerC#)
StarsIn(movie Title , movieYear, starName)
MovieStar(name, address, gender, birthdate)
MovieExec(name, address, cert# , netWorth)
Studio(name, address , presC#)

8.2.a Find the address of MGM studios

SELECT address FROM Studio WHERE name = 'MGM'

8.2.b Find Sandra Bullock's birthday

SELECT birthdate FROM MovieStar WHERE name = 'Sandra Bullock'

8.2.c Find all the stars that appeared either in a movie made in 1980 or a movie with Love in the title

SELECT Star.name FROM MovieStar Star WHERE Star.name IN (SELECT starName FROM StarsIn, Movies WHERE MovieTitle = title AND (Movies.title LIKE %Love%' OR Movies.year = 1980))

8.2.d Find all executive worth at least $10,000,000

SELECT name FROM MovieExec WHERE netWorth > 10000000

8.2.e Find all the stars who either are male or live in Malibu

SELECT name FROM MovieStar WHERE gender = 'male' OR address LIKE '%Malibu%'

8.2.f Who were the male stars in *Titanic*

SELECT name FROM Movies, StarsIn, MovieStar WHERE title = 'Titanic' AND title = movieTitle AND starName = name AND gender = male

8.2.g Which stars appeared in movies produced by MGM in 1995

SELECT starName FROM Movies, StarsIn WHERE studioName = 'MGM' AND title = movieTitle

8.2.h Who is the presiden of MGM Studios

SELECT MovieExec.name FROM Studio, MovieExec WHERE Studio.name = 'MGM' AND presC# = cert#

8.2.i Which movies are longer than *GonewiththeWind*

SELECT title FROM Movies WHERE length > (SELECT length FROM MOVIES WHERE title = 'Gone with the Wind')

8.2.j Which executive are worth more than Merv Griffin

SELECT name FROM MovieExec WHERE netWorth > (SELECT netWorth FROM MovieExec WHERE name = 'Merv Griffin')

8.3 Describe possible values for a and b in the following conditions to be true

8.3.a a = 10 OR b = 20

a is 10, b can be anything including null, and the otherway around

8.3.b a = 10 AND b = 20

Both a has to be 10 and b has to be 20

8.3.c a < 10 OR a >= 10

One of the statements has to be true where the other can both be UNKNOWN by being null or just FALSE be being 11 or higher ot just TRUE.

8.3.d a = b

This will only be true if both have the same value, in case of null it will return UNKNOWN

8.3.e a <= b

If b is higher than a or equal to a it will return true. If one them is null it will be UNKNOWN an otherwise it will be false.

8.4 Write the following queries based on the following tables

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

8.4.a Find the makers of PC's with a speed of at least 3.0

SELECT model FROM PC WHERE speed > 3.0

8.4.b Find the printers with the highest price

SELECT model FROM Printer WHERE price = (SELECT MAX(price) FROM Printer)

8.4.c Find the laptops whose speed is slower than that of any PC

SELECT model FROM Laptop WHERE speed ¡ (SELECT MIN(speed) FROM PC)

8.4.d Find the model number of the item (PC, Laptop, Printer) with the highest price

SELECT model FROM
(SELECT model, price FROM PC UNION SELECT model,price FROM Laptop UNION SELECT model,price FROM Printer)
WHERE price = SELECT MAX(price) FROM
(SELECT MAX(price) FROM PC) UNION (SELECT MAX(price) FROM Laptop) UNION (SELECT MAX(price) FROM Printer))

8.4.e Find the maker of the color printer with lowest price

SELECT model FROM Printer WHERE type=color AND price = (SELECT MIN(price) FROM Printer)