

Algorithms and datastructures Exercises

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6 Week

6.1 Indicate the following according to figure 1.

<i>acctNo</i>	<i>type</i>	<i>balance</i>
12345	savings	12000
23456	checking	1000
34567	savings	25

The relation **Accounts**

<i>firstName</i>	<i>lastName</i>	<i>idNo</i>	<i>account</i>
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 relation

Accounts: *acctNo*, *type*, *balance*

Customers: *firstName*, *lastName*, *idNo*, *account*

6.1.b The tuples of each relation

- 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 tuple of each relation

12000

Banks

6.1.d The relation schema of each relation

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 database 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 Week

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 least 100GB

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

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 laser printers

$$\pi_{model}(\sigma_{color=1 \wedge Dtype=laser}(Printer))$$

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

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

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

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

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

$$\begin{aligned}
ModelPC &= \pi_{model} \sigma_{speed \geq 2.8}(PC) \\
ModelLaptop &= \pi_{model} \sigma_{speed \geq 2.8}(Laptop) \\
models &= ModelPC \cup ModelLaptop \\
mans &= \pi_{maker,model}(models \bowtie Product) \\
twoProduct &= \sigma_{maker2=maker \text{ and } model2 \neq model}(\rho_{maker2,model2} mans \times mans)
\end{aligned}$$

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

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

7.1.j Find manufactures who sell at lest three PC's

$$\begin{aligned}
model &= \rho_{model} PC \\
computers &= model \times model(model2) \times model(model3) \\
models &= \sigma_{model=model2 \text{ and } model2=model3}(computers) \\
mans &= \pi_{maker}(models \bowtie Product)
\end{aligned}$$

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

$$\begin{aligned}
model &= \rho_{model} PC \\
computers &= model \times model(model2) \times model(model3) \\
models &= \sigma_{model=model2 \text{ and } model2=model3}(computers) \\
mans &= \pi_{maker}((models \bowtie Product)
\end{aligned}$$

7.1.1 Find manufactores who sell exactly three PC's

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

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 separated.

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 net-  
Worth 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 $a \geq 10$

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)
```

9 Week

9.1 Write SQL queries for the following database

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

9.1.a What PC models have a speed grater than 3

```
SELECT * FROM PC WHERE speed > 3
```

9.1.b Find model and price for all products made by manufacturer B

```
SELECT price, model FROM PC, Laptop, Printer Where model EXISTS  
(SELECT model FROM product WHERE maker = B)
```

9.1.c Find manufactureres of at least two different computers with speed grather than 2.8

```
SELECT maker FROM (SELECT maker FROM Product WHERE model  
EXIST (SELECT models FROM PC, Laptop Where speed > 2.8)) WHERE  
COUNT(maker) >= 2
```

9.1.d Find the average speed of PC's

```
SELECT AVG(speed) FROM PC
```

9.1.e Find the average speed of laptops costing over \$1000

```
SELECT * FROM Laptops WHERE price > 1000
```


9.1.f Find the average price of PC's and Laptops made by manufacturer "D"

SELECT AVG(price) FROM Laptop, PC WHERE model EXIST (SELECT model FROM Product WHERE maker = 'D')

9.1.g Find for each different speed, the average price of a PC

SELECT AVG(price) FROM PC GROUP BY speed

9.1.h Find for each manufacturer the average screen size of its laptops

SELECT AVG(screen) FROM PC NATURAL JOIN Product GROUP BY maker

9.1.i Find the manufacturers that make at least three different model of PC

SELECT maker FROM PC NATURAL JOIN Product GROUP BY maker HAVING COUNT(*) > 2

9.1.j Find for each manufacturer who selss PC's the maximum price of a PC.

SELECT MAX(price) FROM PC NATURAL JOIN Product GROUP BY maker

9.1.k Find for each speed of PC above 2.0 the average price

SELECT AVG(price) FROM PC GROUP BY speed HAVING speed > 2