Discussion #3

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Outline

- SQL
- Relational Algebra

What is SQL?

- stands for **S**tructured **Q**uery **L**anguage
- the most widely used database language
- used to **query** and **manipulate** the data

Create a table

- To create a new table:

CREATE TABLE <name>(

<attribute1>,
<attribute2>,
…

);

```
CREATE TABLE Author(
        authorid INTEGER PRIMARY KEY,
        firstname CHAR(20) NOT NULL,
        lastname CHAR(30)
    );
```

- Name of table: **Author**
- Attributes: **authorid, firstname, lastname**
- Primary Key: **authorid**

Populating a table

- To insert a single tuple:

INSERT INTO <relation>

VALUES(<list of values>);

```
INSERT INTO Author
VALUES(001, 'Dan', 'Brown');
```

Selection query

- To select specific tuples from a table or more:

SELECT <attributes list>

FROM <one or more tables>

WHERE <conditions on the tables>

- **Example:** What is the population of USA?

SELECT Population

FROM Country

WHERE Code = 'USA'

PROJECTION: keeps only the specified attributes

SELECTION: filters the tuples of the relation

Delete from a table

- To delete tuples satisfying a condition from some relation:

  DELETE FROM <relation>

  WHERE <condition>;

- Example:

  DELETE FROM Order

  WHERE `orderid = 123987;`

Update a tuple in a table

- To change certain attributes in certain tuples of a relation:

  UPDATE <relation>

  SET <list of attribute assignments>

  WHERE <condition on tuples>;

- Example:

  UPDATE Order

  SET product =’avocado'

  WHERE orderid = 900899;

Query with Order By

- Use **ORDER BY** to order the tuples by the attribute we specify in decreasing (**DESC**) or increasing order (**ASC**)
- **Example:** Write a query that will return the order ids and the prices of all the orders with price higher than 100$ in decreasing order.

```
SELECT orderid, price

FROM Order

WHERE price > 100

ORDER BY price DESC;
```

Query with Aggregations

- **SUM, AVG, COUNT, MIN, MAX** can be applied to a column in a **SELECT** clause to produce that aggregation on that column
- **Examples:**
  - Find the average number of the population of European countries

```
SELECT AVG(Population)
FROM Country
WHERE Continent = 'Europe';
```

  - Find the number of employees with age between 30 and 40 and salary greater than 30.000$

```
SELECT COUNT(*)
FROM Employees
WHERE age >= 30 AND age<=40 AND salary > 30.000
```

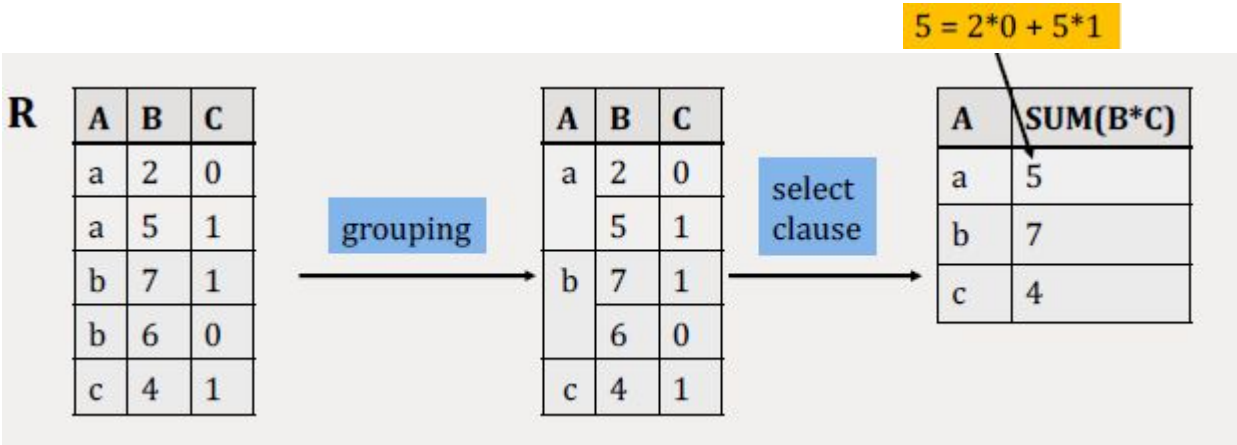
Query with Group By (1)

- We may follow a **SELECT-FROM-WHERE** expression by **GROUP BY** and a list of attributes
- The relation is then grouped according to the values of those attributes, and any aggregation is applied only **within each group**
- Example: Write a query that returns for each continent the number of the countries.

```
SELECT Continent, COUNT(*)
FROM Country
GROUP BY Continent
```

Query with Group By (2)

```
SELECT A, SUM(B*C)
FROM R
GROUP BY A;
```



Queries with Multiple Relations

- We often want to combine data from more than one relation
- We can address several relations in one query by listing them all in the **FROM** clause
- If two attributes from different relations have the same name, we can distinguish them by writing **<relation>.<attribute>**

Query with Inner Join (1)

What is the name of the countries that speak Greek?

```
SELECT Country.Name
FROM Country INNER JOIN CountryLanguage
ON Country.Code = CountryLanguage.CountryCode
WHERE CountryLanguage.Language = 'Greek';
```

Inner Join 1st syntax

OR

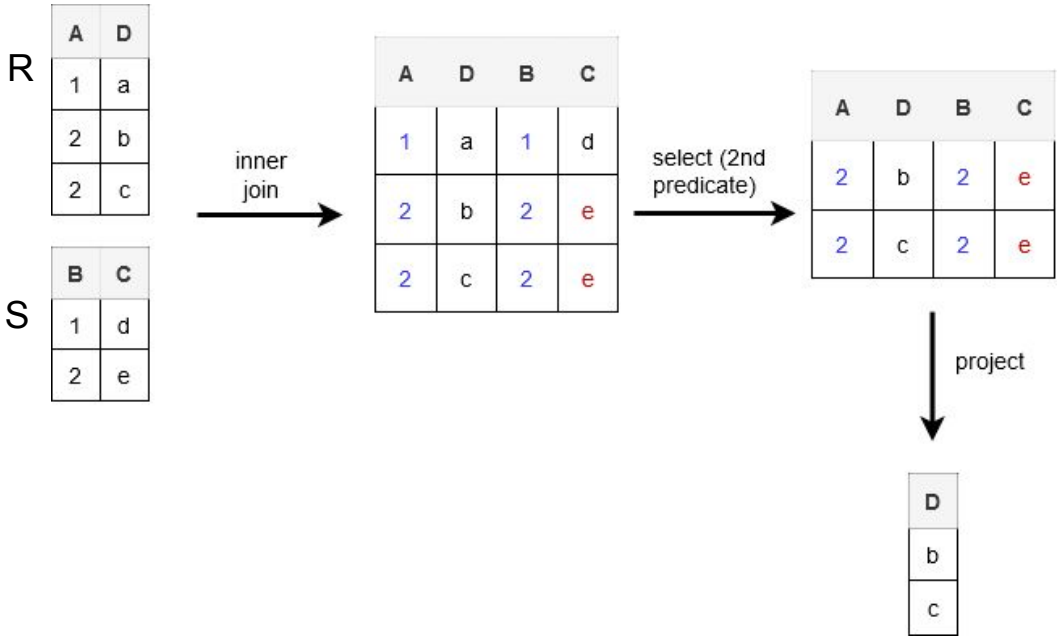
```
SELECT C.Name
FROM Country AS C, CountryLanguage AS L
WHERE C.Code = L.CountryCode
AND L.Language = 'Greek';
```

```
SELECT C.Name
FROM Country AS C INNER JOIN CountryLanguage AS L
ON C.Code = L.CountryCode
WHERE L.Language = 'Greek';
```

Inner Join 2nd syntax

Query with Inner Join (2)

SELECT R.D
FROM R **INNER JOIN** S
ON R.A = S.B
WHERE S.C = ‘e’ ;



Left Outer Join

- A left outer join includes tuples form the left relation even there is no match on the right.
- It fills the remaining attributes with NULL

SELECT A, C
FROM R **LEFT OUTER JOIN** S
ON R.B = S.B

R

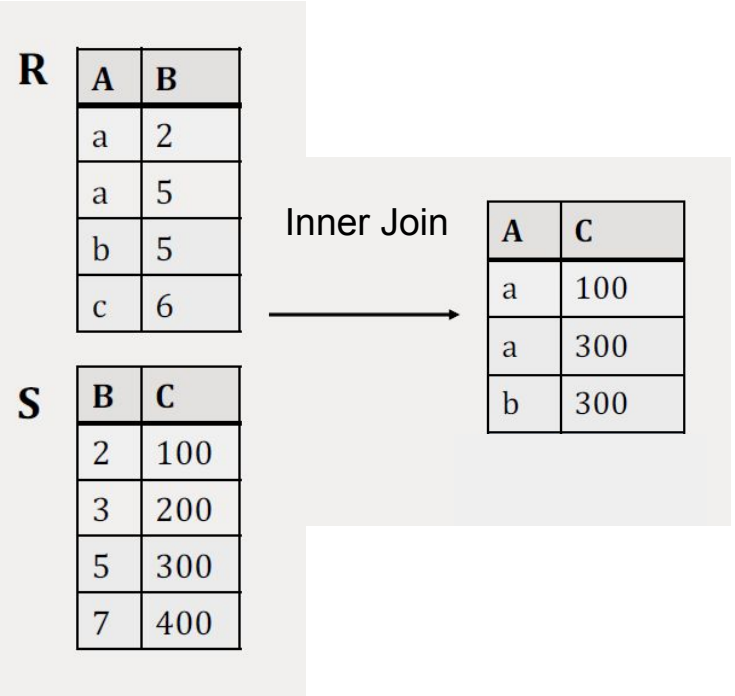
A	B
a	2
a	5
b	5
c	6

S

B	C
2	100
3	200
5	300
7	400

Left Outer Join →

A	C
a	100
a	300
b	300
c	**NULL**



Example - Bank

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 1

Write an SQL query that returns all the account_numbers with balance more than 300.00.

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 1- Answer

Write an SQL query that returns all the account_numbers with balance more than 300.00.

```
SELECT account_number
FROM T1
WHERE  ballance > 300.00;
```

account_number
SDF-989
WER-567
RTY-095

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 2

Write an SQL query that returns the average age of all the clients.

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 2 - Answer

Write an SQL query that returns the average age of all the clients.

```
SELECT AVG(age) AS average
FROM T3;
```

average
36

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 3

Write an SQL query that returns account numbers, first/last names & ages of all clients with age less than 50 in decreasing order based on the age.

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 3- Answer

Write an SQL query that returns account numbers, first/last names & ages of all clients with age less than 50 in decreasing order based on the age.

```
SELECT T2.account_number, T3.first_name, T3.last_name, T3.age
FROM T2 INNER JOIN T3
ON T2.user_id = T3.user_id
WHERE T3.age < 50
ORDER BY T3.age DESC;
```

account_number	first_name	last_name	age
ABZ-123	Mark	Brown	34
SDF-989	Sarah	Johnson	21
WER-567	Sarah	Johnson	21

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 4

Write an SQL query that for every user it returns the total balance of all the accounts that she/he has.

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 4 - Answer

Write an SQL query that for every user it return user_id & the total balance of all the accounts that she/he has.

```
SELECT T2.user_id AS user_id , SUM(T1.balance) AS total_balance
FROM T1 INNER JOIN T2
ON T1.account_number =T2.account_numer
GROUP BY T2.user_id
```

user_id	total_balance
U1	230.00
U2	810.00
U3	750.00

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 5 - Extra Example

Write an SQL query that for every user it returns hers/his first/last name and the total balance of all the accounts that she/he has.

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Query 5 - Extra Example Answer

Write an SQL query that for every user it returns hers/his first/last name and the total balance of all the accounts that she/he has.

```
SELECT T3.first_name AS firstname, T3.last_name as lastname, SUM(T1.ballance) AS total_balance
FROM T1 INNER JOIN T2
ON T1.account_number =T2.account_numer
INNER JOIN T3
ON T2.user_id = T3.user_id
GROUP BY T2.user_id, T3.first_name, T3.last_name
```

firstname	lastname	total_balance
Mark	Brown	230.00
Sarah	Johnson	810.00
Sarah	Johnson	750.00

T1

account_number	ballance
ABZ-123	230.00
SDF-989	450.00
WER-567	360.00
RTY-095	750.00

T2

account_number	user_id
ABZ-123	U1
SDF-989	U2
WER-567	U2
RTY-095	U3

T3

user_id	first_name	last_name	age
U1	Mark	Brown	34
U2	Sarah	Johnson	21
U3	Betty	Mcgrath	53

Relational Algebra

- ‘Algebra’:
  - Operands --- variables or values from which new values can be constructed.
  - Operators --- symbols denoting procedures that construct new values from given values.

- Relational Algebra:
  - An algebra whose operands are relations or variables that represent relations.
  - Mainly provides theoretical foundation for relational databases and SQL.

At a glance

- Union (∪), intersection (∩), and difference (-)
  - Usual set operations, but both operands must have the same relation schema.
- Selection (σ)
  - picking certain rows.
- Projection (Π)
  - picking certain columns.
- Products (x) and joins (⋈)
  - compositions of relations.
- Renaming of relations and attributes (ρ).

Theta Join

A join that involves a predicate

Notation: $R1 \bowtie_{\theta} R2$, where θ is a condition.

Input schemas: R1(A1,…,An), R2(B1,…,Bm)

Output schema: S(A1,…,An,B1,…,Bm)

Derived operator:

$$R1 \bowtie_{\theta} R2 = \sigma_{\theta}(R1 \times R2)$$

- θ: '=' refers to as Equi-Join.

Sells

bar	beer	price
Joe's	Bud	2.50
Joe's	Miller	2.75
Sue's	Bud	2.50
Sue's	Coors	3.00

Bars

name	addr
Joe's	Maple St.
Sue's	River Rd.

BarInfo = Sells ⋈ Sells.bar = Bars.name Bars

BarInfo

bar	beer	price	name	addr
Joe's	Bud	2.50	Joe's	Maple St.
Joe's	Miller	2.75	Joe's	Maple St.
Sue's	Bud	2.50	Sue's	River Rd.
Sue's	Coors	3.00	Sue's	River Rd.

Natural Join

The natural join connects two relations by:

- Equating attributes of the same name, and
- Projecting out one copy of each pair of equated attributes.

Denoted R3 := R1⋈R2

Employee

Name	SSN
John	999999999
Tony	777777777

Dependents

SSN	Dname
999999999	Emily
777777777	Joe

Employee $\bowtie$ **Dependents =**

$\Pi_{\text{Name, SSN, Dname}}(\sigma_{\text{SSN=SSN2}}(\text{Employee} \times \rho_{\text{SSN2, Dname}}(\text{Dependents}))$

Name	SSN	Dname
John	999999999	Emily
Tony	777777777	Joe

65

Inner Join: Natural Join, Theta Join, Equi-Join

Outer Join

An extension of the join operation that avoids loss of information.

Computes the join and then adds tuples from one relation that does not match tuples in the other relation to the result of the join.

loan

loan-number	branch-number	amount
1234	001	3000
3421	002	4000
9987	012	1700

borrower

customer-id	loan-number
201	1234
304	3421
425	2342

- **Inner Join**

loan ⋈ *Borrower*

loan-number	branch-id	amount	customer-name
1234	001	3000	201
3421	002	4000	304

- **Left Outer Join**

loan ⟕ *borrower*

loan-number	branch-name	amount	customer-id
1234	001	3000	201
3421	002	4000	304
9987	012	1700	*null*

- **Right Outer Join:**

loan ⟖ *borrower*

loan-number	branch-id	amount	customer-id
1234	001	3000	201
3421	002	4000	304
2342	null	null	425

- **Full Outer Join**

loan ⟗ *borrower*

loan-number	branch-id	amount	customer-id
1234	001	3000	201
3421	002	4000	304
9987	012	1700	*null*
2342	null	null	*425*

Precedence Rule

Precedence of relational operators:

1. [σ, π, ρ] (highest)
2. [X, ⋈]
3. ⋂
4. [∪ , -]

→ Use brackets, if you are not sure.

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of boats.

1. Π_{name}(Boats)
2. σ_{name}(Boats)

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
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104	Marine	red

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1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

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1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List ratings and ages sailors.

1. $\Pi_{\text{rating, ages}}(\text{Sailors})$
2. $\Pi_{\text{rating}}(\text{Sailors}) \cup \Pi_{\text{ages}}(\text{Sailors})$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
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4	Zorba	8	18
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sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

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Boat Problem

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Boats (bid, name, color)

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104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of sailors who are over 26 years old.

1. $\sigma_{age>26}(\Pi_{name}(Sailors))$
2. $\Pi_{name}(\sigma_{age>26}(Sailors))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
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103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

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1. $\sigma_{age>26}(\Pi_{name}(Sailors))$
2. $\Pi_{name}(\sigma_{age>26}(Sailors))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
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Boats (bid, name, color)

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sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of red boats.

1. $\sigma_{color = red}(\Pi_{name}(Boats))$
2. $\Pi_{name}(\sigma_{color = red}(Boats))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
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Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of red boats.

1. $\sigma_{color = red}(\Pi_{name}(Boats))$
2. $\Pi_{name}(\sigma_{color = red}(Boats))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

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bid	name	color
101	Interlake	blue
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104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Try These!

Q. List ids of boats named Interlake.

Q. List ids of boats reserved on 7/11/12 and 10/11/12.

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of sailors who reserved boat 101.

1. $\Pi_{name}(\sigma_{bid = 101}(Sailors \bowtie Reserves))$
2. $\Pi_{name}(Sailors \bowtie (\sigma_{bid = 101}(Reserves)))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of sailors who reserved boat 101.

1. $\Pi_{name}(\sigma_{bid = 101}(Sailors \bowtie Reserves))$
2. $\Pi_{name}(Sailors \bowtie (\sigma_{bid = 101}(Reserves)))$

Better ?

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of sailors who reserved the blue Interlake.

1. $\Pi_{Sailors.name}(Sailors \bowtie \sigma_{name = Interlake \text{ and } color = blue}(Boats) \bowtie Reserves)$

2. $\Pi_{Sailors.name}(\sigma_{name = Interlake \text{ and } color = blue}(Sailors \bowtie Reserves))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of sailors who reserved the blue Interlake.

1. $\Pi_{Sailors.name}(Sailors \bowtie \sigma_{name = Interlake \text{ and } color = blue}(Boats) \bowtie Reserves)$

2. $\Pi_{Sailors.name}(\sigma_{name = Interlake \text{ and } color = blue}(Sailors \bowtie Reserves))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of boats that were reserved by Julius.

1. $\sigma_{\text{Sailors.name = Julius}} (\Pi_{\text{Boats.name}}(\text{Sailors} \bowtie \text{Boats} \bowtie \text{Reserves}))$

2. $\Pi_{\text{Boats.name}}(\sigma_{\text{Sailors.name = Julius}} (\text{Sailors}) \bowtie \text{Boats} \bowtie \text{Reserves}))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List names of boats that were reserved by Julius.

1. $\sigma_{\text{Sailors.name = Julius}}$ ($\Pi_{\text{Boats.name}}$(Sailors $\bowtie$ Boats$\bowtie$ Reserves))

2. $\Pi_{\text{Boats.name}}$($\sigma_{\text{Sailors.name = Julius}}$ (Sailors) $\bowtie$ Boats$\bowtie$ Reserves))

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List days on which some sailor with rating higher than 6 was at sea.

1. $\Pi_{day}(\sigma_{rating > 6}(Sailors) \bowtie Reserves))$
2. $\Pi_{day}(\sigma_{rating > 6}(Sailors) \bowtie Boats \bowtie Reserves))$

Boat Problem

Sailors (sid, name, rating, age)

sid	name	rating	age
1	Dustin	7	45
2	Rusty	10	35
3	Horatio	5	35
4	Zorba	8	18
5	Julius		25

Boats (bid, name, color)

bid	name	color
101	Interlake	blue
102	Interlake	red
103	Clipper	green
104	Marine	red

Reserves (sid, bid, day)

sid	bid	day
1	101	10/10/12
1	102	10/10/12
1	101	10/7/12
2	102	11/9/12
2	102	7/11/12
3	101	7/11/12
3	102	7/8/12
4	103	19/9/12

Q. List days on which some sailor with rating higher than 6 was at sea.

1. $\Pi_{day}(\sigma_{rating > 6}(Sailors) \bowtie Reserves))$
2. $\Pi_{day}(\sigma_{rating > 6}(Sailors) \bowtie Boats \bowtie Reserves))$

Better ?

Music Album Problem

Q. List the titles and length of all songs written by swiss artists (nationality) in 2000.

A. $\Pi_{\text{title, length}}(\sigma_{\text{writtenYear=2000}}(\text{song}) \bowtie_{\text{writtenBy = name}} \sigma_{\text{nationality = 'swiss'}}(\text{artist}))$

song

title	length	writtenBy	writtenYear
De Charybde en Scylla	5:35	Louis Sclavis	2008
Un Vent Noir	3:40	Louis Sclavis	2008
Standing Ovation	4:26	Louis Sclavis	1995
moto [ein weltbewusstsein.]	6:00	Michael Wertmueller	2000

songInAlbum

song	album	trackNumber
De Charybde en Scylla	Lost on the Way	1
Un Vent Noir	Lost on the Way	9
Standing Ovation	Carnet De Routes	1
moto [ein weltbewusstsein.]	Werthmueller	4

album

aTitle	releaseYear	producedBy	playedBy
Lost on the Way	2008	ECM	Louis Sclavis
Carnet de Routes	1995	Label Blue	Louis Sclavis
Werthmueller	2005	GROB	Steamboat Switzerland

artist

name	nationality
Louis Sclavis	french
Steamboat Switzerland	swiss
Michael Wertmueller	swiss

label

name	revenue
Sony	50,000,000
ECM	3,000,000
Label Bleu	150,000
GROB	10,000

Music Album Problem

Q. List the names of labels that produced at least one album in 2005.

A. $\Pi_{name}(\sigma_{releaseYear=2005}(album) \bowtie_{producedBy = name} label)$

song

title	length	writtenBy	writtenYear
De Charybde en Scylla	5:35	Louis Sclavis	2008
Un Vent Noir	3:40	Louis Sclavis	2008
Standing Ovation	4:26	Louis Sclavis	1995
moto [ein weltbewusstsein.]	6:00	Michael Wertmueller	2000

songInAlbum

song	album	trackNumber
De Charybde en Scylla	Lost on the Way	1
Un Vent Noir	Lost on the Way	9
Standing Ovation	Carnet De Routes	1
moto [ein weltbewusstsein.]	Werthmueller	4

album

aTitle	releaseYear	producedBy	playedBy
Lost on the Way	2008	ECM	Louis Sclavis
Carnet de Routes	1995	Label Blue	Louis Sclavis
Werthmueller	2005	GROB	Steamboat Switzerland

artist

name	nationality
Louis Sclavis	french
Steamboat Switzerland	swiss
Michael Wertmueller	swiss

label

name	revenue
Sony	50,000,000
ECM	3,000,000
Label Bleu	150,000
GROB	10,000

Music Album Problem

Q. List labels that have not released (producedBy) any albums by swiss artists.

ans ← π_{name}(label) − swissL

Try forming swissL.

song

title	length	writtenBy	writtenYear
De Charybde en Scylla	5:35	Louis Sclavis	2008
Un Vent Noir	3:40	Louis Sclavis	2008
Standing Ovation	4:26	Louis Sclavis	1995
moto [ein weltbewusstsein.]	6:00	Michael Wertmueller	2000

songInAlbum

song	album	trackNumber
De Charybde en Scylla	Lost on the Way	1
Un Vent Noir	Lost on the Way	9
Standing Ovation	Carnet De Routes	1
moto [ein weltbewusstsein.]	Werthmueller	4

album

aTitle	releaseYear	producedBy	playedBy
Lost on the Way	2008	ECM	Louis Sclavis
Carnet de Routes	1995	Label Blue	Louis Sclavis
Werthmueller	2005	GROB	Steamboat Switzerland

artist

name	nationality
Louis Sclavis	french
Steamboat Switzerland	swiss
Michael Wertmueller	swiss

label

name	revenue
Sony	50,000,000
ECM	3,000,000
Label Bleu	150,000
GROB	10,000

SQL to RA

```
SELECT theater, time
FROM Schedule
WHERE title = 'Shrek' AND time >=
'15:00:00'
```

Q. Convert in RA.

A.

Schedule(Theater, Title, Time)

Movies(Title, Director, Actor)

Produced(Producer, Title)

See(Spectator, Title)

Liked(Spectator, Title)

SQL to RA

```
SELECT theater, time

FROM Schedule

WHERE title = 'Shrek' AND time >=
'15:00:00'
```

Q. Convert in RA.

A. $\Pi_{\text{theater, time}}(\sigma_{\text{title = 'Shrek' and time >= 15:00}}\ (\text{Schedule}))$

Meaning: List the theater name and time where I can see the movie "Shrek" after 3pm.

Schedule(Theater, Title, Time)

Movies(Title, Director, Actor)

Produced(Producer, Title)

See(Spectator, Title)

Liked(Spectator, Title)

SQL to RA

```
SELECT Producer
FROM Produced
WHERE title IN (SELECT title
FROM MOVIES EXCEPT
SELECT title FROM Schedule )
```

Schedule(Theater, Title, Time)

Movies(Title, Director, Actor)

Produced(Producer, Title)

See(Spectator, Title)

Liked(Spectator, Title)

Q. Convert in RA.

A.

SQL to RA

```
SELECT Producer
FROM Produced
WHERE title IN (SELECT title
FROM MOVIES EXCEPT
SELECT title FROM Schedule )
```

Schedule(Theater, Title, Time)

Movies(Title, Director, Actor)

Produced(Producer, Title)

See(Spectator, Title)

Liked(Spectator, Title)

Q. Convert in RA.

A. $\Pi_{producer}(Produced \bowtie (\Pi_{title}(Movies) - \Pi_{title}(Schedule)))$

Meaning: List the producers who produced a movie that does not appear in a theater.

SQL to RA

```
SELECT Spectator
FROM (SELECT Spectator, Title
FROM Liked EXCEPT
SELECT Spectator, Title
FROM See)
```

Q. Convert in RA.

A.

Schedule(Theater, Title, Time)

Movies(Title, Director, Actor)

Produced(Producer, Title)

See(Spectator, Title)

Liked(Spectator, Title)

SQL to RA

```
SELECT Spectator
FROM (SELECT Spectator, Title
FROM Liked EXCEPT
SELECT Spectator, Title
FROM See)
```

Schedule(Theater, Title, Time)

Movies(Title, Director, Actor)

Produced(Producer, Title)

See(Spectator, Title)

Liked(Spectator, Title)

Q. Convert in RA.

A. $\Pi_{Spectator}$(Liked - See)

Meaning: List people who liked movies that they have not seen.

Thanks!