

Student - Table Name

Name	SSN	Address	GPA	→ Attribute Name
Jim	1234	Durham	3.2	rows / tuples
Mary	5678	Lee	3.8	
Jack	9876	Modbury	NULL	
⋮	⋮	⋮	⋮	

Attributes / columns

NULL list students with

GPA	>	3.5	} Jack is not listed
	≤	3.5	
	≠	3.5	

## Relational Algebra

Chapter 8: 8.1, 8.2

old edition: Ch 6: 6.1, 6.2

## Set Theory

\* Every table is a set.

STUDENT ≡ set

Name	SSN	Address	GPA
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Jim	1234	Durham	3.2
Mary	5678	Lee	3.8
Jack	9876	Madbury	NULL
⋮	⋮	⋮	⋮

Every row is an element of STUDENT

$$\{1, 1, 1, 2, 2, 3, 3, 3\} = \{1, 2, 3\}$$

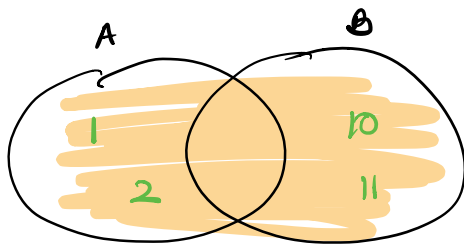
⇒ duplicates are removed.

\* MySQL duplicates not removed.

$$\{1, 2, 3, 4\} = \{2, 4, 3, 1\}$$

⇒ tuple ordering does not matter.

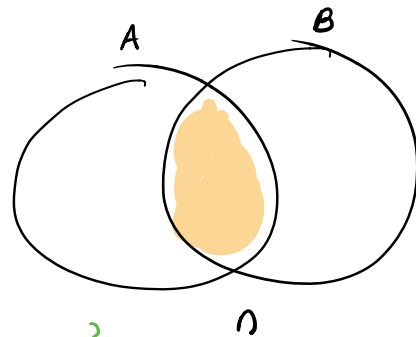
Set operators : A, B



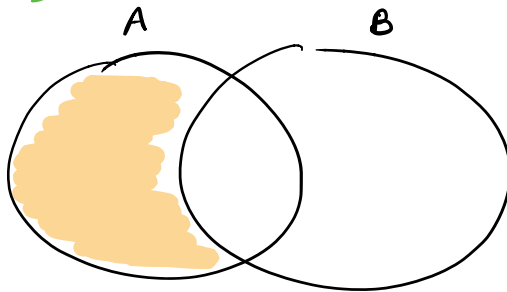
U

$$A \cup B = \{1, 2, 10, 11\}$$

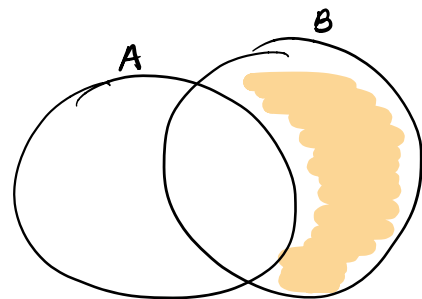
$$\{(1, 10), (2, 11)\}$$



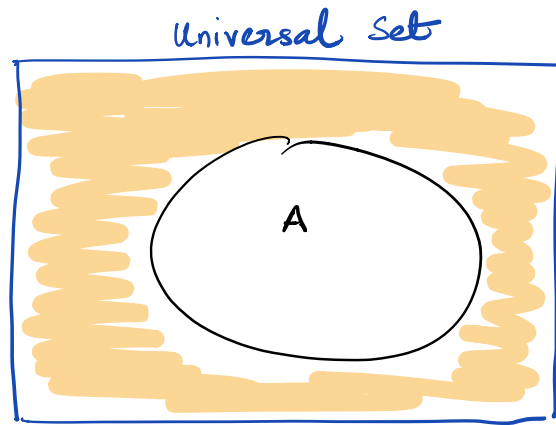
∩



A - B



B - A



$A'$  : A complement

$A \times B$  : cross product  
cartesian product

$$A = \{1, 2, 3\}$$

$$B = \{a, b\}$$

$$A \times B = \{ (1, a) \quad (1, b) \\ (2, a) \quad (2, b) \\ (3, a) \quad (3, b) \}$$

Foundations of SQL :

\* Set operators:  $\cup, \cap, \times, -$

\* Unary operators:  $\sigma, \pi$   
 $\downarrow$  select       $\downarrow$  project

\* Binary operators:  $\bowtie \rightarrow$  join

\* closed w.r.t. operations (i.e., output is table)

Example Database: COMPANY

① EMPLOYEE

- entire table is listed.


②  $\sigma$ : select some rows.


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Query: List employees from department 4.

$\sim_{DNO=4} (\text{EMPLOYEE})$

Query: List emp with salary > 40000

$\sigma_{\text{salary}} > 40000$  (EMPLOYEE)

Query: Emp with (salary > 20000 in dno=4)  
OR (salary > 40000)

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$(\text{dno} = 4 \wedge \text{salary} > 20000) \vee (\text{salary} > 40000)$  (Emp)

$\downarrow$  and  $\downarrow$  or

③  $\Pi$  : Project : pick some columns

Query: List each employees frame, lname.

$\Pi_{\text{frame, lname}} (\text{EMPLOYEE})$

Query: list sex, salary of employees  
 $\Pi_{\text{sex, salary}} (\text{Employee})$

Query: List department #s.

$\Pi_{\text{Dnumber}} (\text{DEPARTMENT})$

Dnumber
5
4
1


Query: List Fname, salary of employees in department 5.

\* Pick some rows & some columns

$\Pi_{\text{Frame, salary}} (\sigma_{\text{Dno}=5} (\text{EMPLOYEE}))$

OR

$\sigma_{\text{Dno}=5} (\Pi_{\text{Frame, salary}} (\text{EMPLOYEE}))$



Frame	Salary
John	30000
Frank	20000
Alicia	:
Jennifer	:
Remesh	:
Joye	
Ahmed	
James	

Frame			Salary -	Dno
John				5
Frank				5
Remesh				5

Joye			5
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OR

Temp  $\leftarrow \sigma_{dno=5} (Employee)$

Result  $\leftarrow \pi_{Name, salary} (Temp)$  ✓

Query: List the last name and salary of emp in dep = 5 who earn more than 30000.