Database Systems(2)

Tutorial 2

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1. Review in database systems 1:

1.1What is a database systems:

A database is an organized collection of structured information, or data, typically stored electronically in a computer system.

A database is usually controlled by a database management system(DBMS).

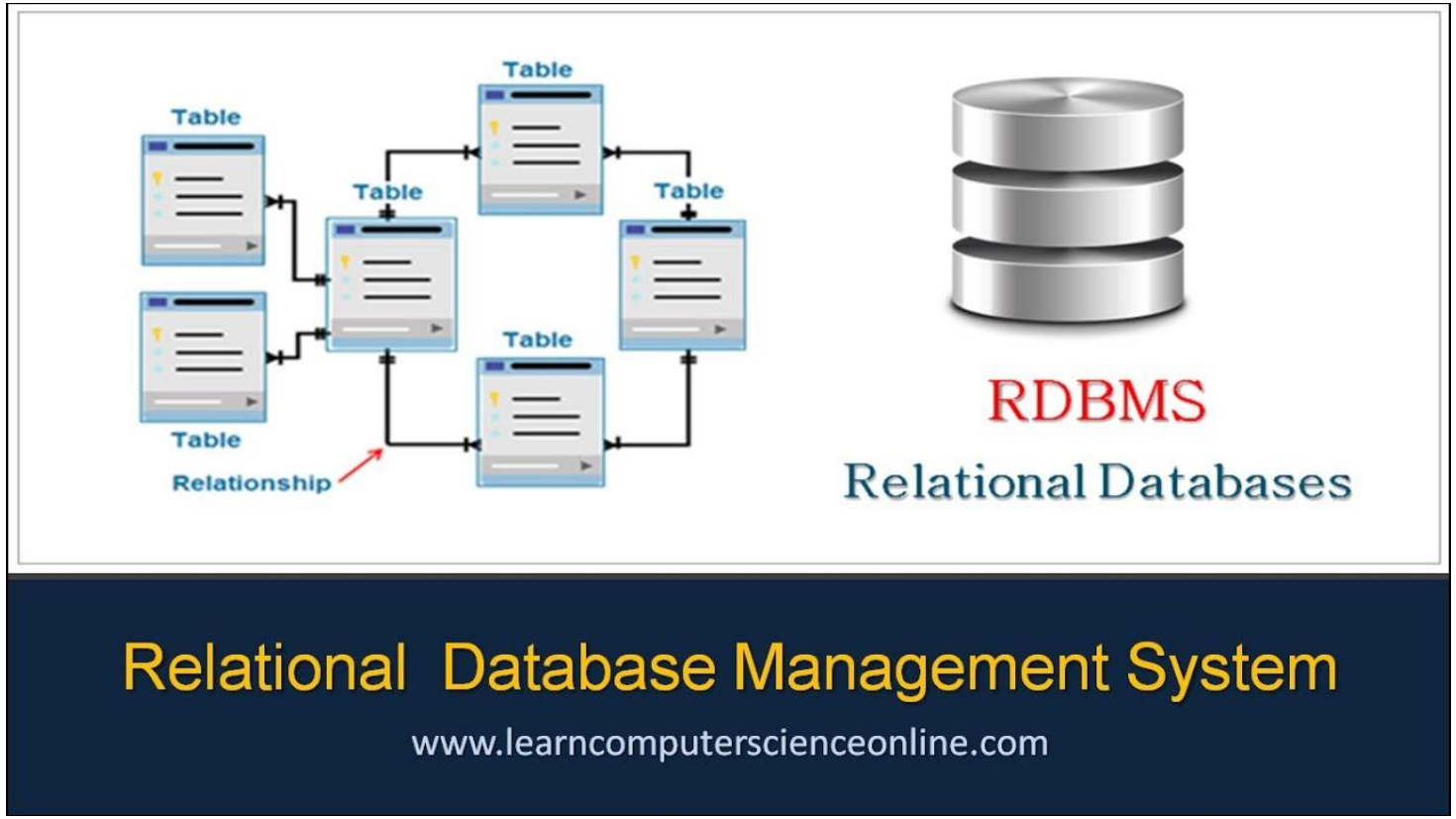
1.2What is a database management systems(DBMS):

A database typically requires a comprehensive database software program known as a database management system (DBMS).

A DBMS serves as an interface between the database and its end users or programs, allowing users to retrieve, update, and manage how the information is organized and optimized.

1.3 What is a relational database management systems(RDBMS):

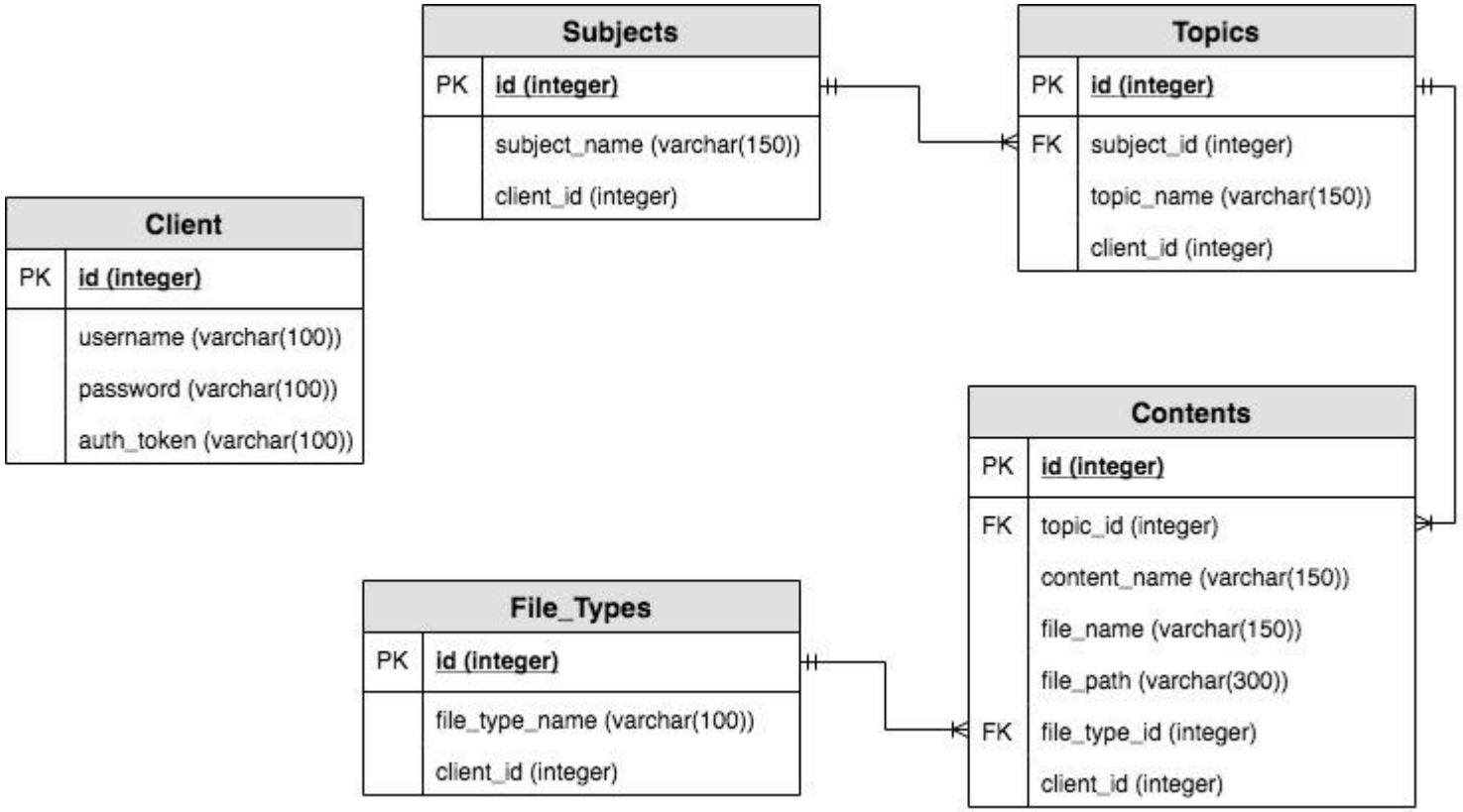
A relational database management system (RDBMS or just RDB) is a common type of database that stores data in tables, so it can be used in relation to other stored datasets.



1.4 What is a Relational database schema:

A database schema is an abstract design that represents the storage of your data in a database.

It describes both the organization of data and the relationships between tables in each database.



1.5 Normalization:

Normalization is a database design technique that reduces data redundancy and eliminates undesirable characteristics.

Normalization rules divides larger tables into smaller tables and links them using relationships.

The purpose of **Normalization in SQL** is to eliminate redundant (repetitive) data and ensure data is stored logically.

1NF

Customer Firstname	Customer Lastname	Item 1	Item 2
Joe	Bloggs	Baked beans	Bread

2NF

Customer Firstname	Customer Lastname	Item
Joe	Bloggs	Baked beans
Joe	Bloggs	Bread

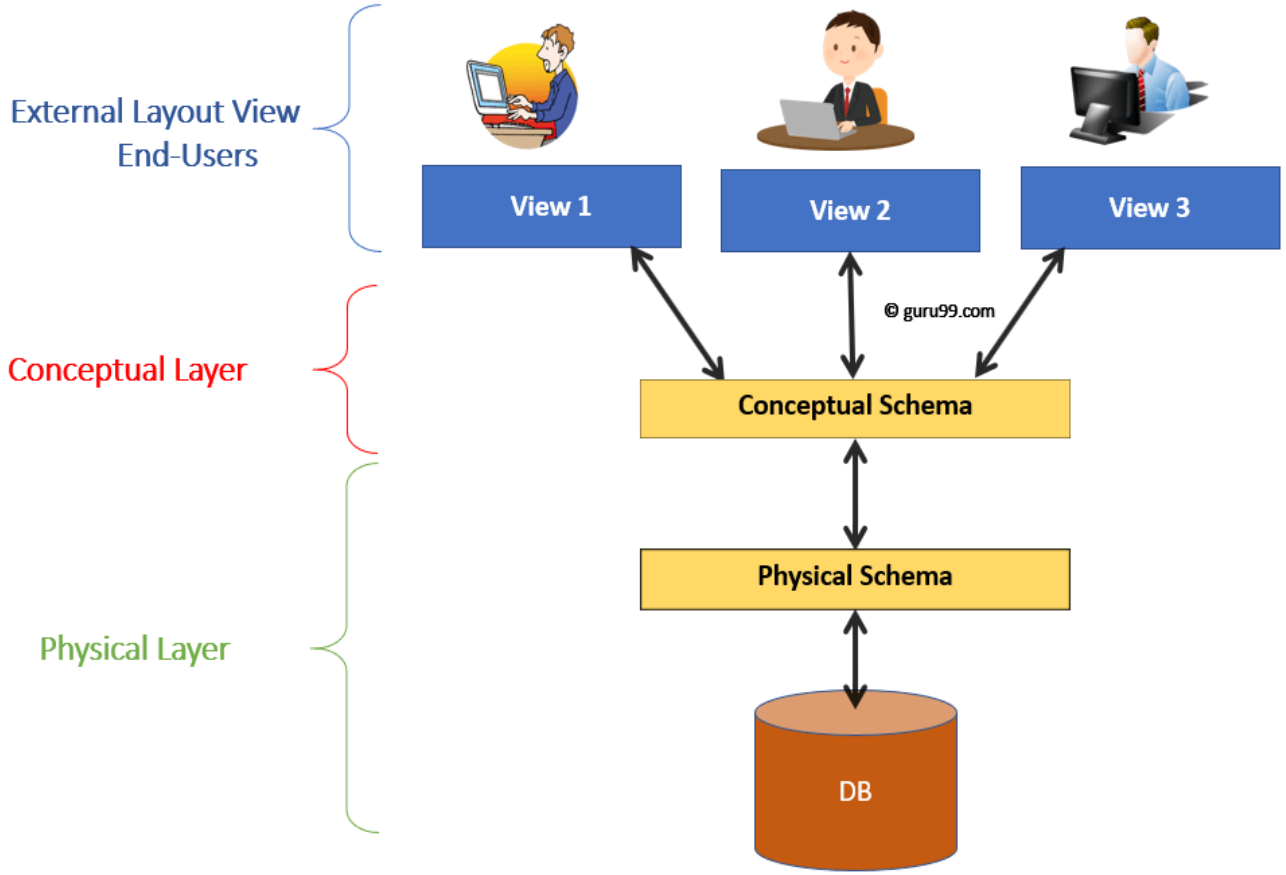
3NF

Customer ID	Customer Firstname	Customer Lastname
1	Joe	Bloggs
2	Jeff	Smith

Item ID	Item
1	Baked beans
2	Bread

Customer ID	Item
1	Baked beans
2	Bread

1.6 Architecture of database schema:



1.6 Architecture of database schema:

Conceptual layer (Logical): A conceptual database schema represents how the data is organized in terms of tables. It also explains how attributes from tables are linked together.

Note: Integrity constraints are a set of rules for a DBMS that maintain quality for data insertion and updates.

To create a conceptual database schema, we use tools to illustrate relationships between components of your data. This is called entity-relationship modeling (ER Modeling). It specifies what the relationships between entity types are.

- **Primary key:** identify a record in the table.
- **Foreign key:** primary key for another table.

Physical layer: The physical database schema represents how data is stored on disk storage. In other words, it is the actual code that will be used to create the structure of your database.

Note: Compared to the logical schema, it includes the database table names, column names, and data types.

1.7 What is DDL and DML:

DDL:

1. Is Data Definition Language which is used to define data structures. For example: create table, alter table are instructions in SQL.

2. Basic command present in DDL are CREATE, DROP, RENAME, ALTER.

DML:

1. Is Data Manipulation Language which is used to manipulate data itself. For example: insert, update, delete are instructions in SQL.

2. BASIC command present in DML are UPDATE, INSERT, MERGE.

2. Relational Algebra:

2.1 Why it is important:

Relational algebra defines the basic set of operations of relational database model. The result of this expression represents the result of a database query.

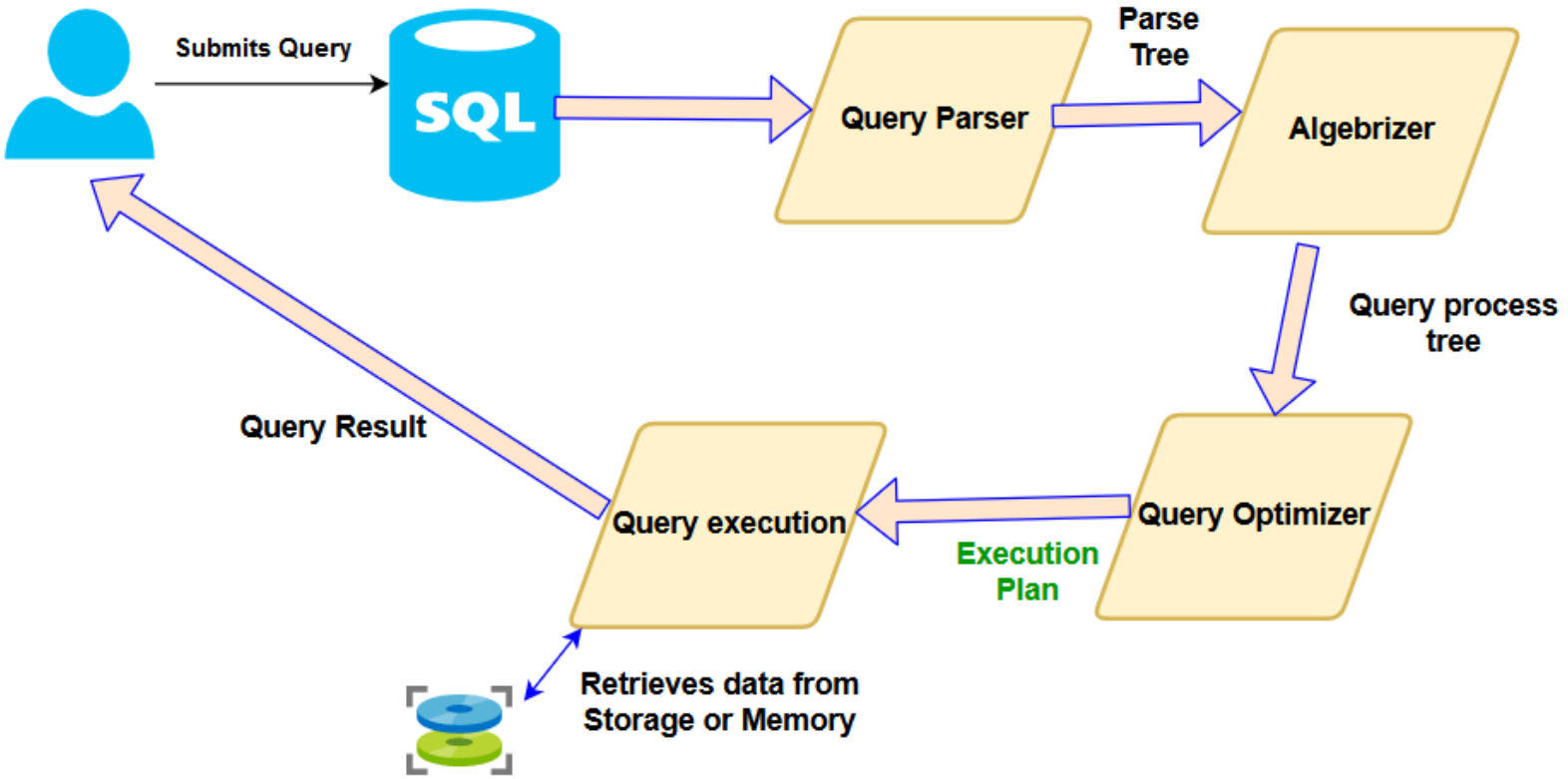
The basic operations are:

Projection, Selection

Union, Intersection

Minus, Join

2.2 What is query optimizer:



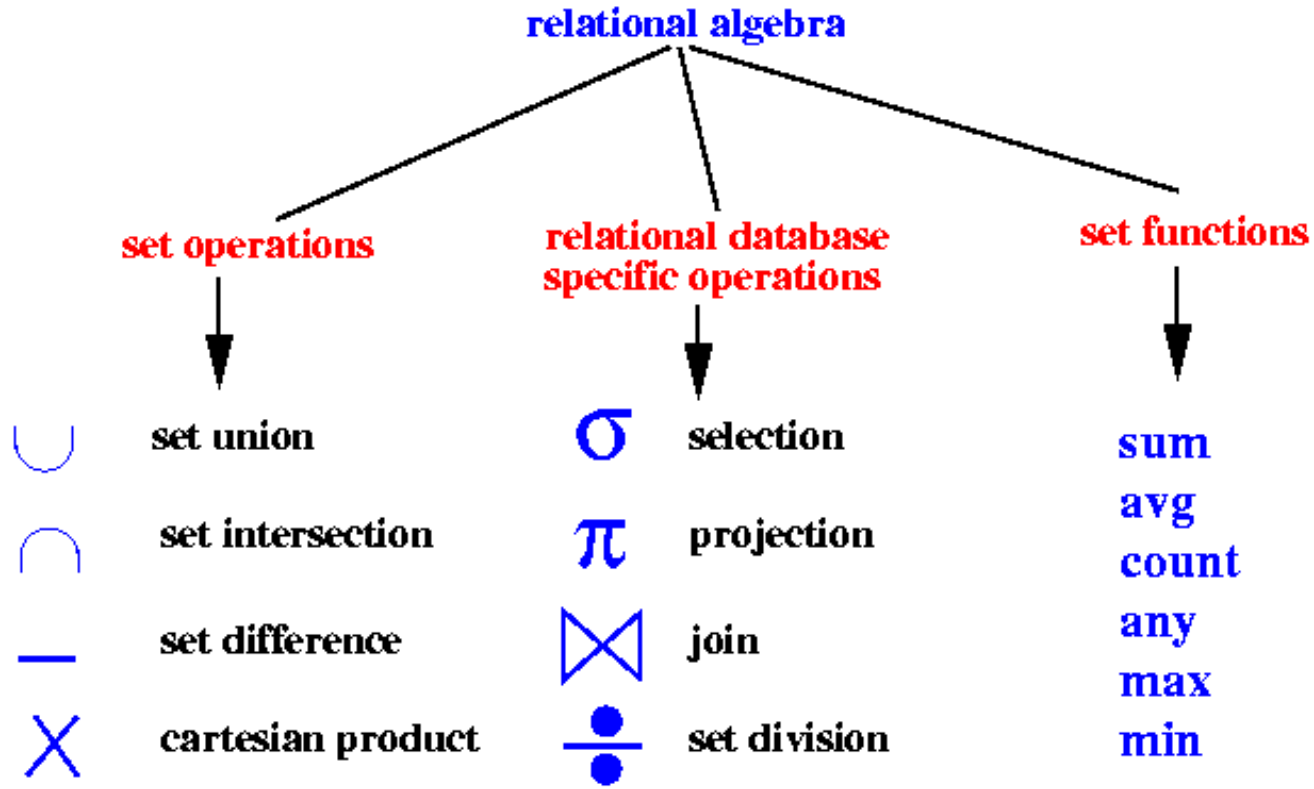
2.2 What is query plan:

A query plan (or query execution plan) is a sequence of steps used to access data in a SQL relational database management system.

This is a specific case of the relational model concept of access plans.

Since SQL is declarative, there are typically many alternative ways to execute a given query, with widely varying performance. When a query is submitted to the database, the query optimizer evaluates some of the different, correct possible plans for executing the query and returns what it considers the best option.

2.3 Classification of Relational algebra operations:



Selection with Projection Example

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO
John		Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin		Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia		Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer		Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh		Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce		English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad		Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James		Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	null	1

$$\pi_{\text{LNAME, FNAME, SALARY}} (\sigma_{\text{DNO=5}}(\text{EMPLOYEE}))$$

FNAME	LNAME	SALARY
John	Smith	30000
Franklin	Wong	40000
Ramesh	Narayan	38000
Joyce	English	25000

Other Projection Examples

$$\pi_{\text{LNAME, FNAME, SALARY}}(\text{EMPLOYEE})$$

LNAME	FNAME	SALARY
Smith	John	30000
Wong	Franklin	40000
Zelaya	Alicia	25000
Wallace	Jennifer	43000
Narayan	Ramesh	38000
English	Joyce	25000
Jabbar	Ahmad	25000
Borg	James	55000

$$\pi_{\text{SEX, SALARY}}(\text{EMPLOYEE})$$

SEX	SALARY
M	30000
M	40000
F	25000
F	43000
M	38000
M	25000
M	55000

Projection & Join Example:

Employee table		
eid	ename	did
101	Vivek	10
102	Akash	20
103	Ajay	30

Department table	
did	dname
10	IPF
20	HR
40	TIS

$\Pi_{eid,dname}(Employee \bowtie Department)$

eid	dname
101	IPF
102	HR

Cartesian Product Example

EMP

ENO	ENAME	TITLE
E1	J. Doe	Elect. Eng
E2	M. Smith	Syst. Anal.
E3	A. Lee	Mech. Eng.
E4	J. Miller	Programmer
E5	B. Casey	Syst. Anal.
E6	L. Chu	Elect. Eng.
E7	R. Davis	Mech. Eng.
E8	J. Jones	Syst. Anal.

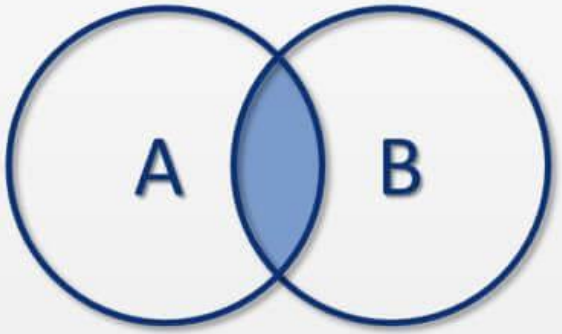
SAL

TITLE	SAL
Elect. Eng.	40000
Syst. Anal.	34000
Mech. Eng.	27000
Programmer	24000

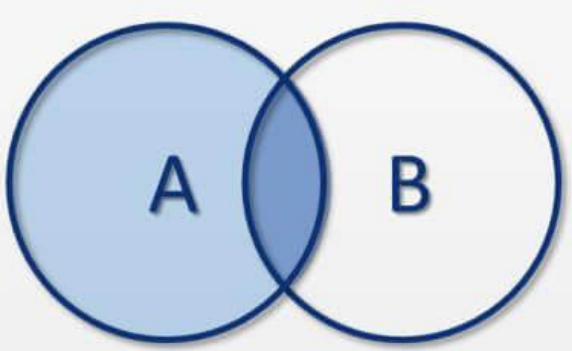
EMP × SAL

ENO	ENAME	EMP.TITLE	SAL.TITLE	SAL
E1	J. Doe	Elect. Eng.	Elect. Eng.	40000
E1	J. Doe	Elect. Eng.	Syst. Anal.	34000
E1	J. Doe	Elect. Eng.	Mech. Eng.	27000
E1	J. Doe	Elect. Eng.	Programmer	24000
E2	M. Smith	Syst. Anal.	Elect. Eng.	40000
E2	M. Smith	Syst. Anal.	Syst. Anal.	34000
E2	M. Smith	Syst. Anal.	Mech. Eng.	27000
E2	M. Smith	Syst. Anal.	Programmer	24000
E3	A. Lee	Mech. Eng.	Elect. Eng.	40000
E3	A. Lee	Mech. Eng.	Syst. Anal.	34000
E3	A. Lee	Mech. Eng.	Mech. Eng.	27000
E3	A. Lee	Mech. Eng.	Programmer	24000
E8	J. Jones	Syst. Anal.	Elect. Eng.	40000
E8	J. Jones	Syst. Anal.	Syst. Anal.	34000
E8	J. Jones	Syst. Anal.	Mech. Eng.	27000
E8	J. Jones	Syst. Anal.	Programmer	24000

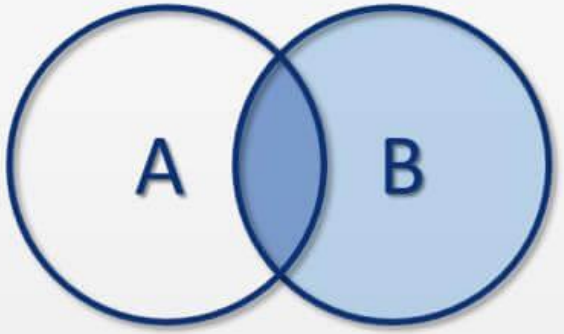
INNER JOIN



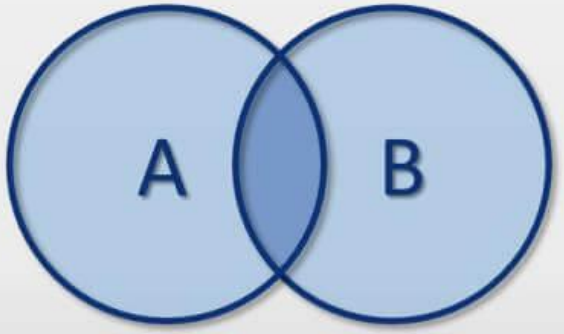
OUTER JOIN



LEFT



RIGHT



FULL

Algebra Operators (Join)

T

A	B
a	1
b	2

U

B	C
1	x
1	y
3	z

Cartesian Product

A	B	B	C
a	1	1	x
a	1	1	y
a	1	3	z
b	2	1	x
b	2	1	y
b	2	3	z

Theta Join

A	B	B	C
b	2	1	x
b	2	1	y

EquiJoin

A	B	B	C
a	1	1	x
a	1	1	y

Natural Join

A	B	C
a	1	x
a	1	y

SemiJoin

A	B
a	1

Outer Join

A	B	C
a	1	x
a	1	y
b	2	

Examples of Division A/B

sno	pno
s1	p1
s1	p2
s1	p3
s1	p4
s2	p1
s2	p2
s3	p2
s4	p2
s4	p4

A

pno
p2

B1

pno
p2
p4

B2

pno
p1
p2
p4

B3

sno
s1
s2
s3
s4

A/B1

sno
s1
s4

A/B2

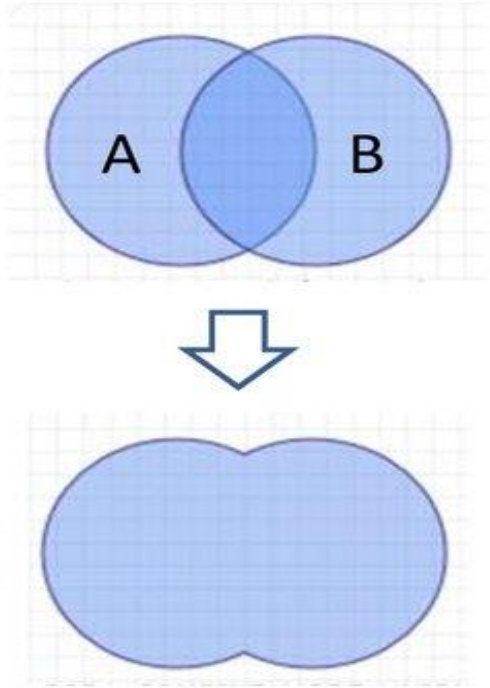
sno
s1

A/B3

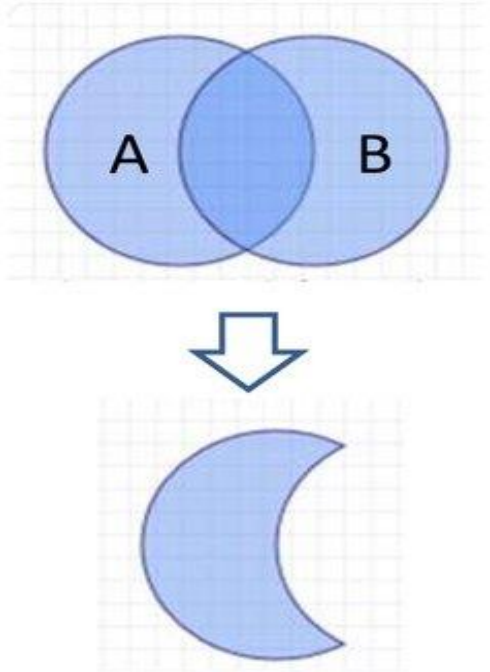
Set Operations
UNION, INTERSECTION, MINUS

The next group of relational algebra operations are the standard mathematical operations on sets.

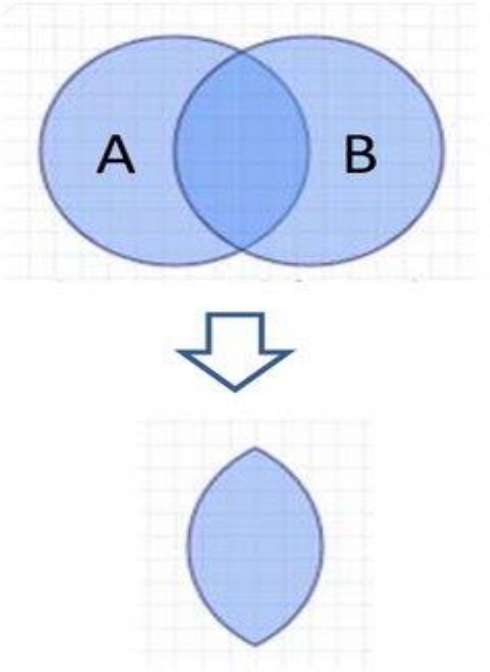
UNION



MINUS



INTERSECTION



Course_1

C_id	C_name
11	Foundation C
21	C++
31	JAVA

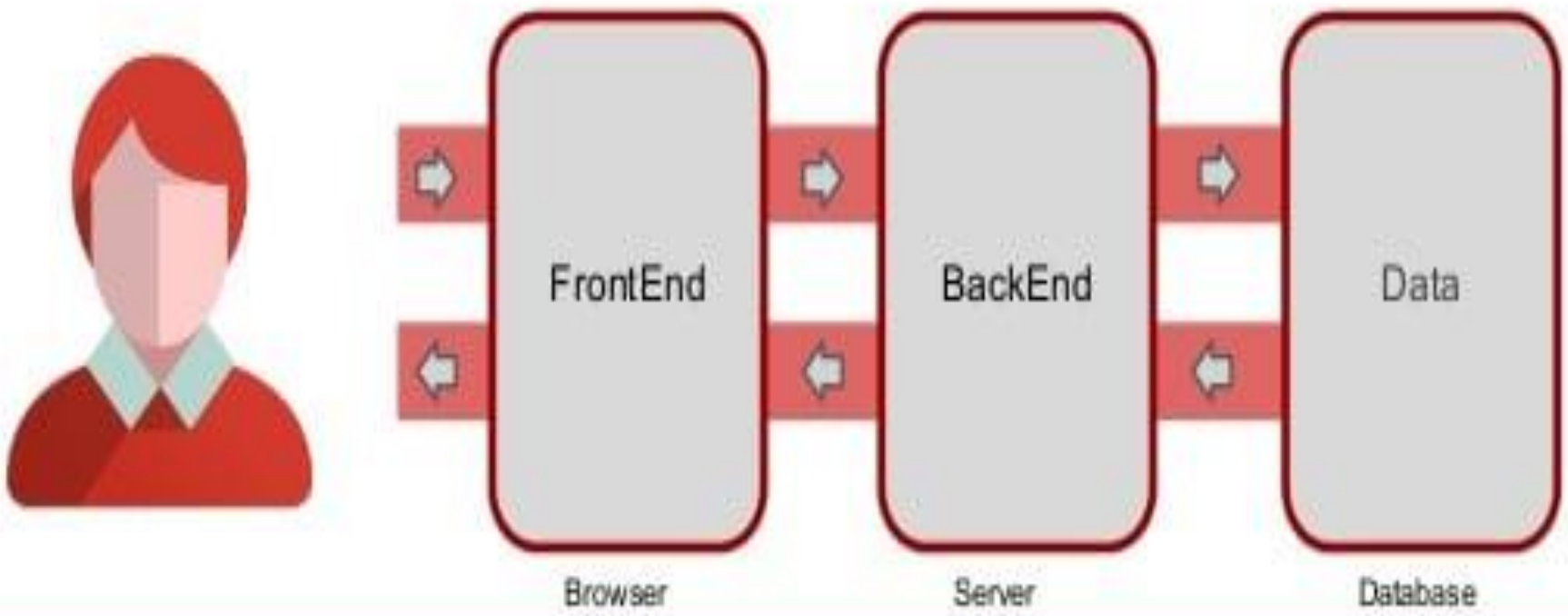
Course_2

C_id	C_name
12	Python
21	C++

Course_1 - Course_2

C_id	C_name
11	Foundation C
31	JAVA

Web Applications architecture



Discussion about projects