



Database Management System

Mizanur Rahman

Mentor, (Next Level Web Development)

Web Developer, (Neptune)

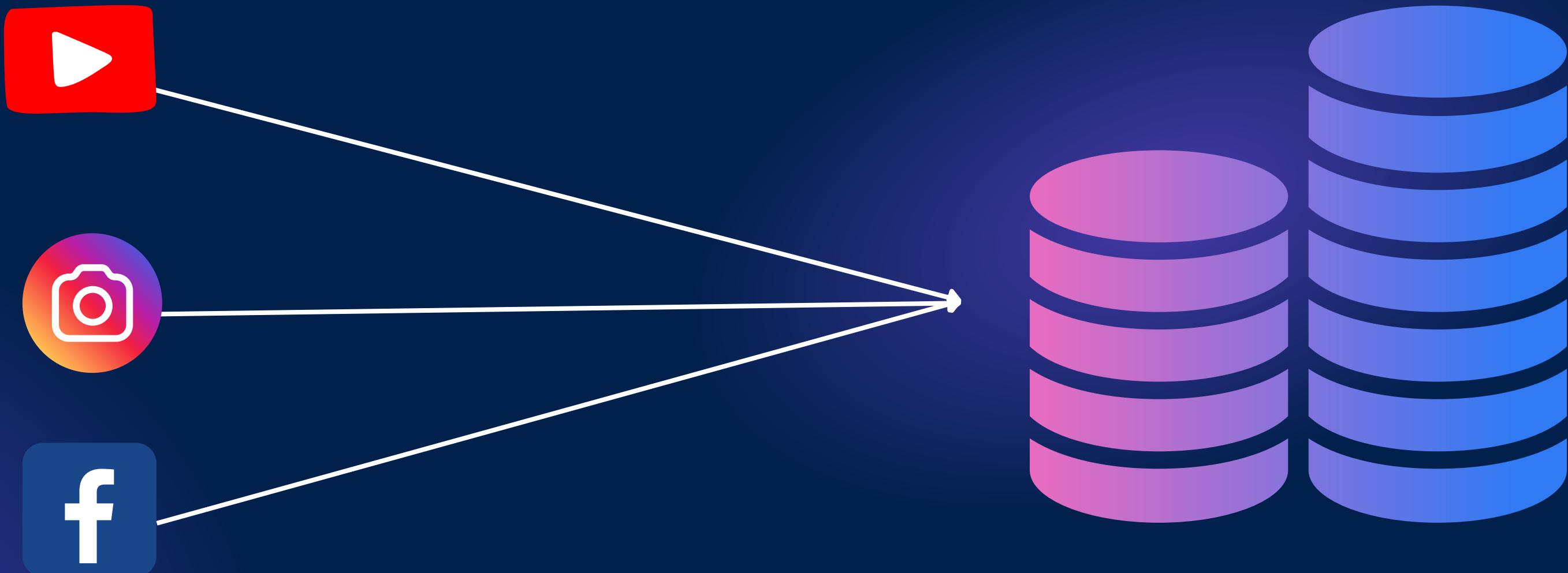
What is database?

What is database?



A database is a structured collection of related data, organized for efficient storage, retrieval, and management.

Data is everywhere



What is data?

What is data?

Data is facts that can be recorded in the form of..

What is information?

What is information?

Information is processed and organized data that provides meaningful context, insight, or knowledge

What is information?

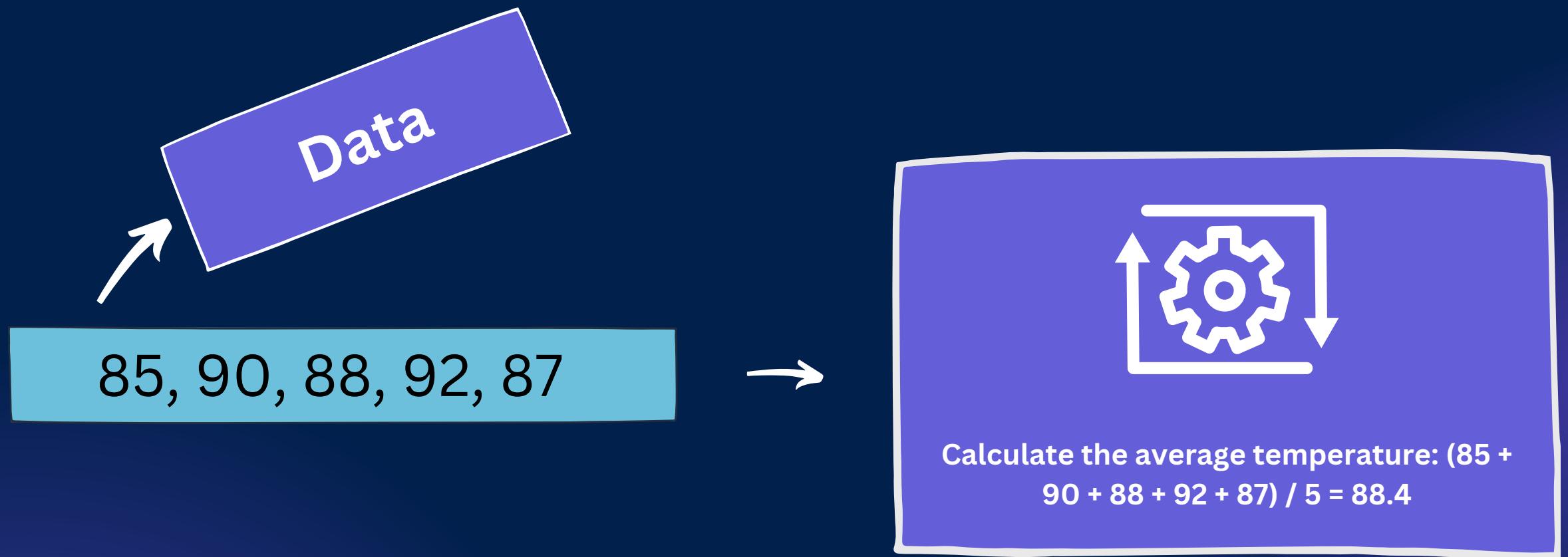
85, 90, 88, 92, 87

What is information?

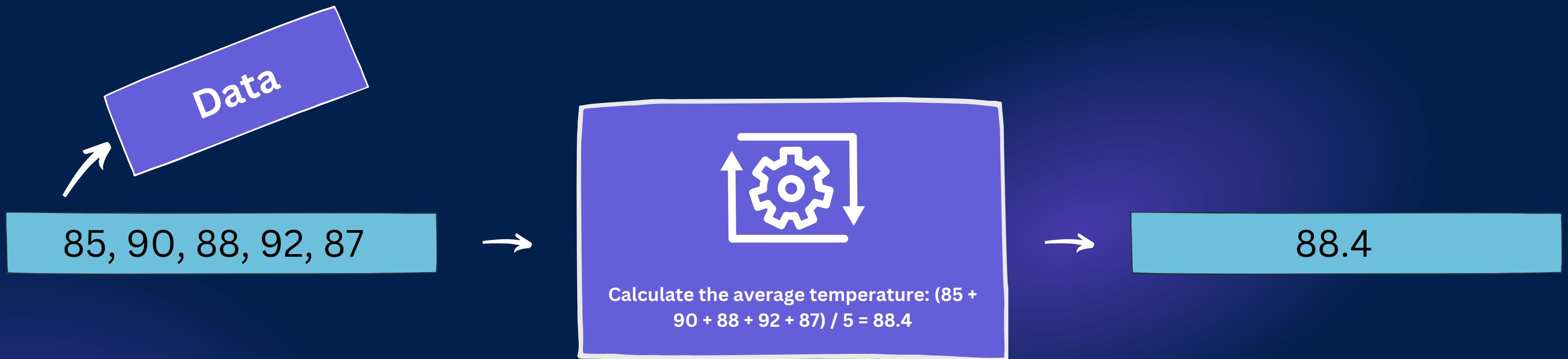
Data

85, 90, 88, 92, 87

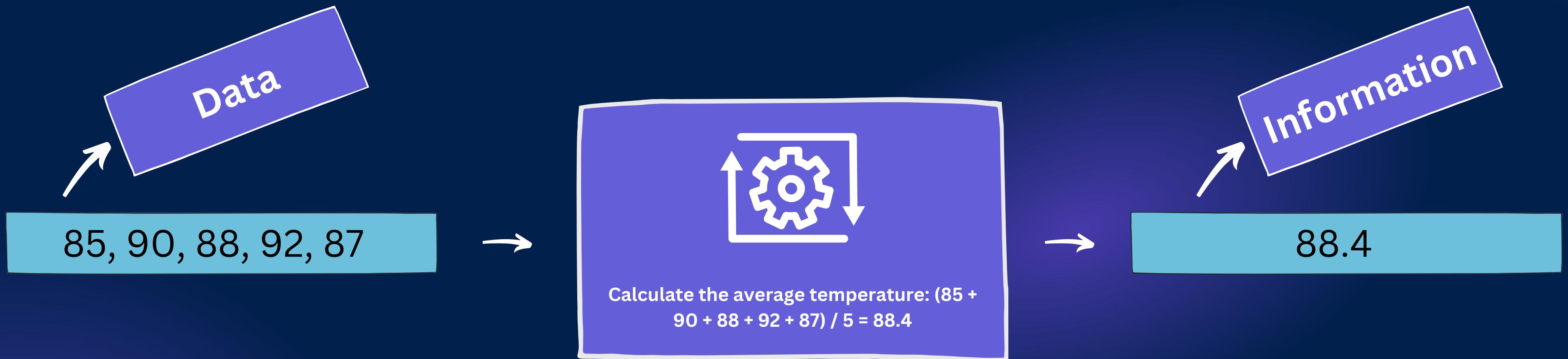
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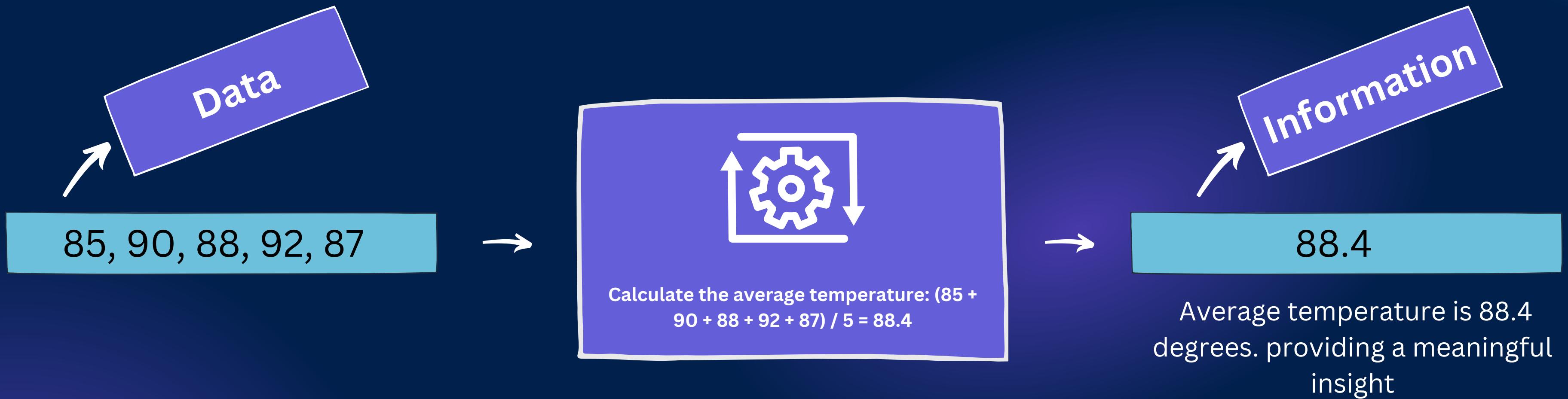
What is information?



What is information?



What is information?



End

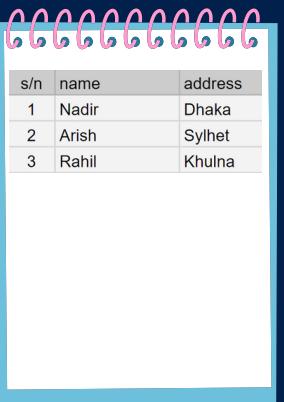
DBMS

DBMS

Database Management System

Storing Data Using File System

s/n	name	address
1	Nadir	Dhaka
2	Arish	Sylhet
3	Rahil	Khulna



- Multiple formats (.txt .mp4, etc)
- Data redundancy
- Data inconsistency
- No concurrency protocol
- Security issue

Storing Data Using File System

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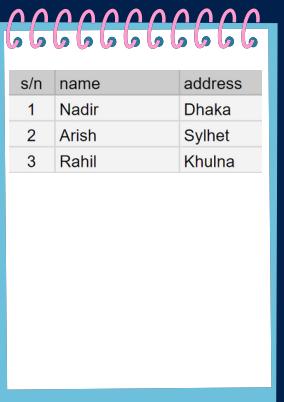
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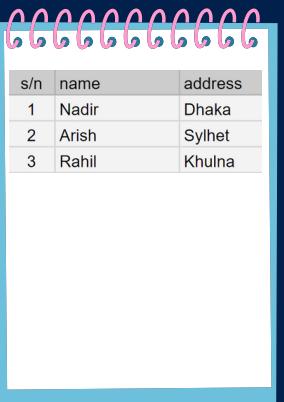
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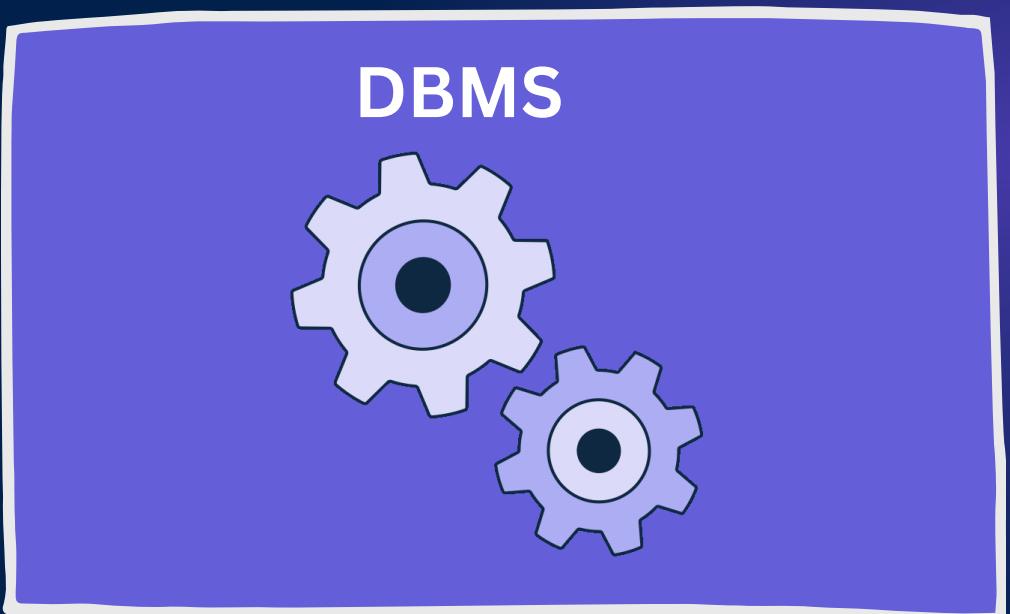


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DBMS

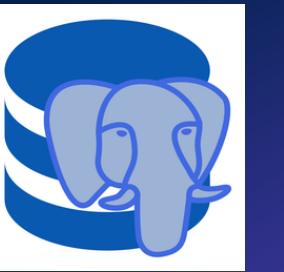
Database Management System

s/n	name	address
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Types of Database

Relational



Document



key value



Database Model

Database Model

Hierarchical

Network

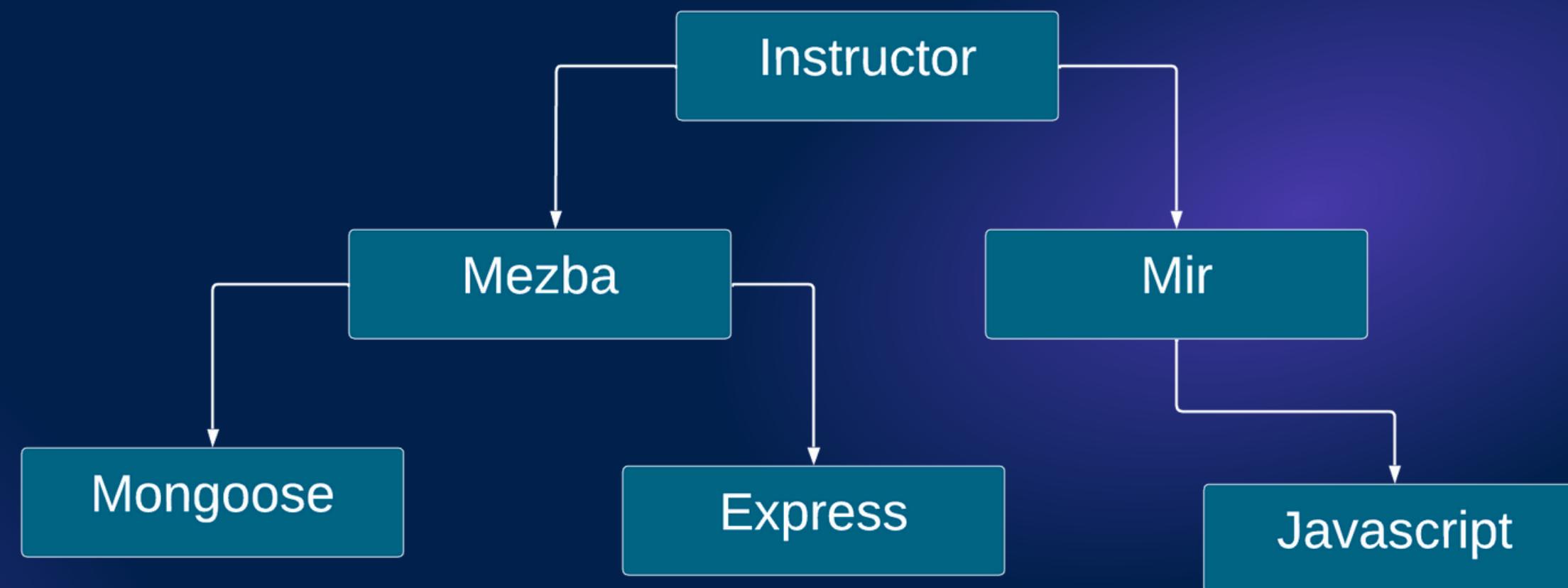
Relational

Document

key value

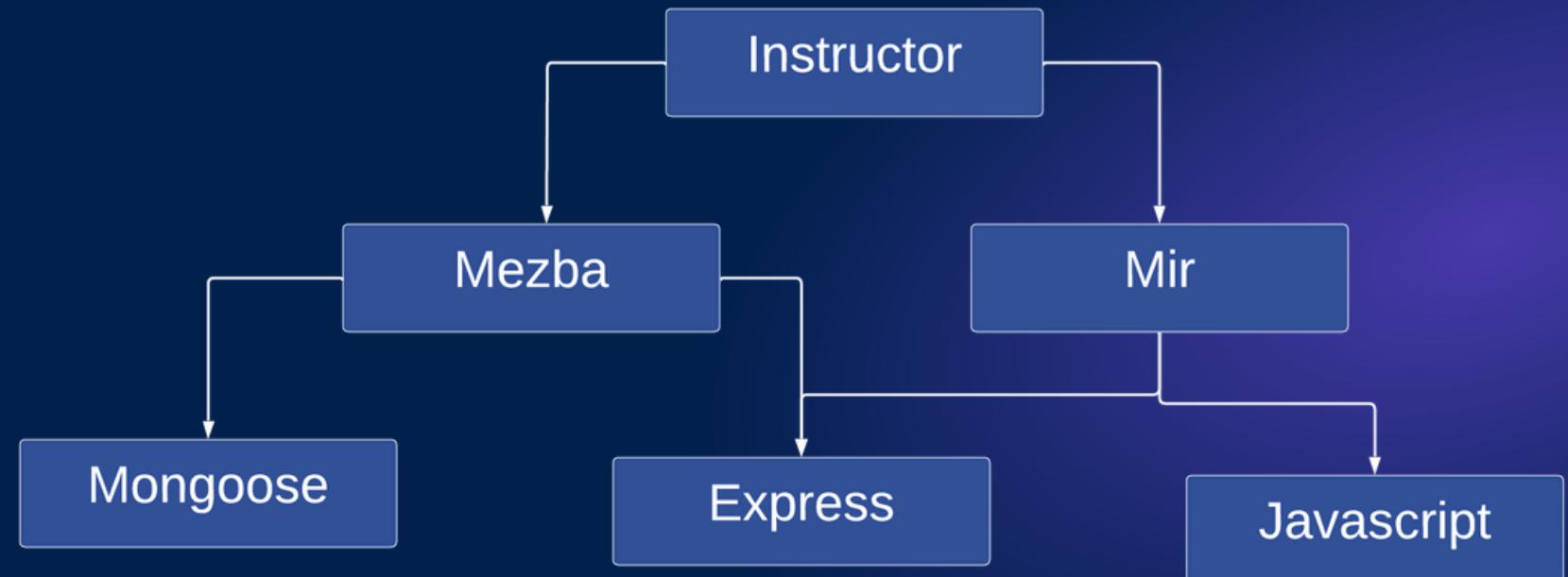
Database Models

Hierarchical



Database Models

Network



Complexity

Schema Definition

Lack of Standardization

Database Models

Relational

Database Models

Relational

u_id	name	address	phone
1	Nadir	Dhaka	123456
2	Arish	Sylhet	236598
3	Rahil	Khulna	895634
4	Arish	Sylhet	896528



o_id	product	price
1	prod1	500
2	prod2	520
3	prod3	300

Database Models

Relational

u_id	name	address	phone
1	Nadir	Dhaka	123456
2	Arish	Sylhet	236598
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Database Models

Relational

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o_id	product	price	u_id
1	prod1	500	2
2	prod2	520	3
3	prod3	300	3

Database Models

Relational

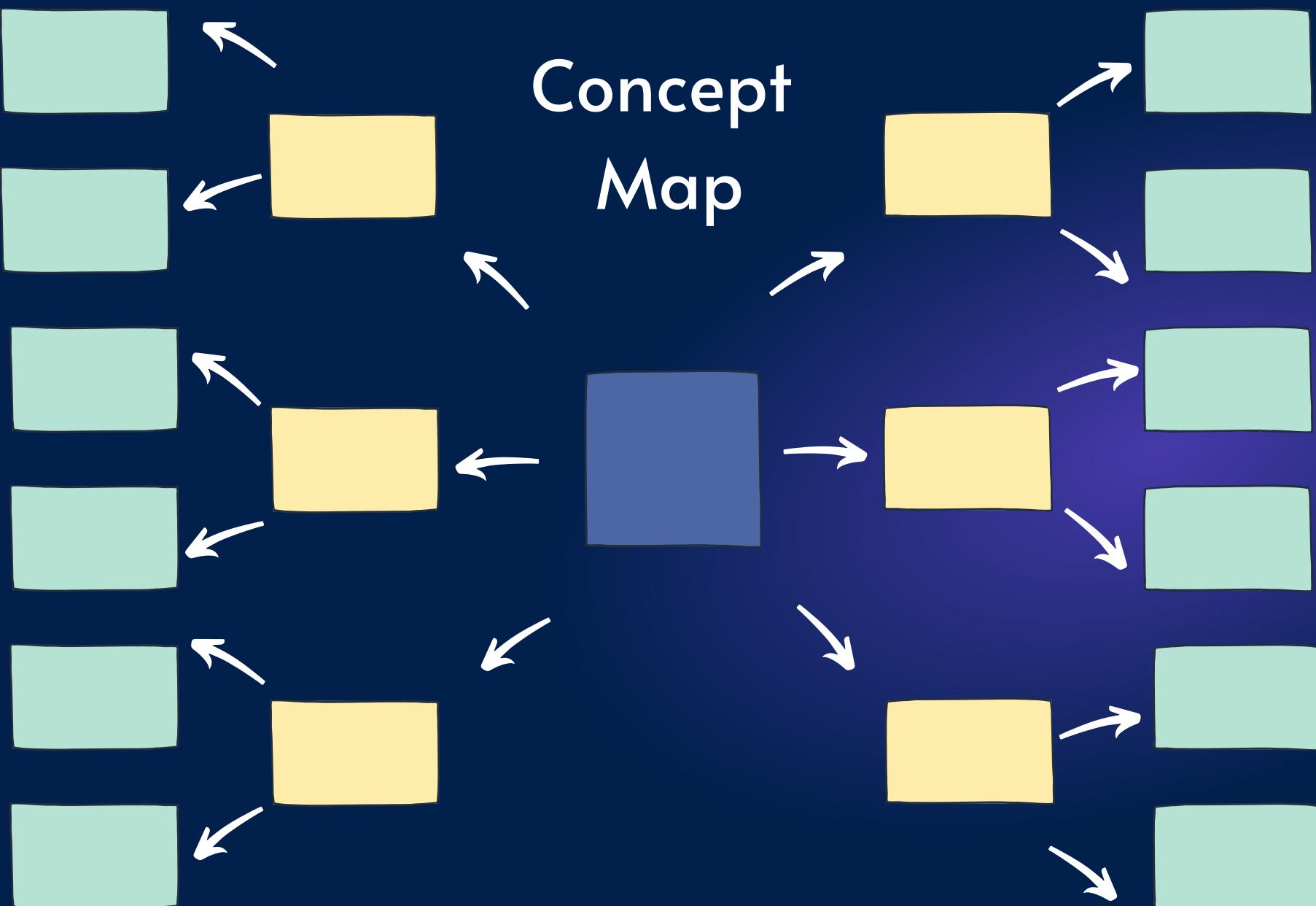
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User

o_id	product	price	u_id
1	prod1	500	2
2	prod2	520	3
3	prod3	300	3

Order

Concept Map



Relational

Table/Relation

Table/Relation

id	name	email	gender	dob
1	Arisha	arisha@mail.com	female	1985-03-15
2	Nour	nour@mail.com	male	1990-07-28
3	Omar	omar.h@email.net	male	2001-02-03
4	Hassan	hassan@email.org	male	1998-07-22

Table/Relation

User

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Table/Relation

Column/Attribute

User

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Table/Relation

Column/Attribute

User

Constraint / Domain

Email Only

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Table/Relation

Rows/Tuples/
Records

Column/Attribute

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Cardinality

Table/Relation

Rows/Tuples/
Records

Column/Attribute

User

Constraint / Domain

Email Only

Constraint / Domain

Date Only

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1	Arisha	arisha@mail.com	female	1985-03-15
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4	Hassan	hassan@email.org	male	1998-07-22

Cardinality

Degree (Collection of column)

Keys

Keys

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel24@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
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Key: A key in a relational database is a field or a combination of fields that uniquely identifies a record in a table.

Keys

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- Super Key
- Candidate Key
- Primary Key
- ALternate Key
- Composite Key
- Foreign Key

Super Key

Super Key

User

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1	Arish	arish@mail.com	male	15
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- Attribute or set of attribute by which we can identify each row uniquely
- Could be a single attribute or a set of attributes
- Could have null values in the set

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 - Could have null values in the set
- {u_id}, {u_id, name}, {u_id, email}, {u_id, name, email, gender, age}, {name, email}, {name, gender}
- {...}

Super Key

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{u_id, name}

{...}

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{u_id, name}

{6, null}

- Attribute or set of attribute by which we can identify each row uniquely

- Could be a single attribute or a set of attributes

- Could have null values in the set

{u_id}, {u_id, name}, {u_id, email}, {u_id, name, email, gender, age}, {name, email}, {name, gender}

{...}

Candidate Key

Candidate Key

User

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- Super key whose **proper** subset is not a super key
- Also called **Minimal Super key**
- Potential Primary Key: From the candidate keys, one is chosen as the primary key

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Set

Set

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

Set

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

Subset of A = {}, {1}, {2}, {3}, {1,2}, {2,3}, {1,3}, {1,2,3}

Set

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

Subset of A = {}, {1}, {2}, {3}, {1,2}, {2,3}, {1,3}, {1,2,3}

Proper subset of A = {}, {1}, {2}, {3}, {1,2}, {1,3}, {2,3}

Candidate Key

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Super Key: {u_id}, {email}, {u_id, name}, {u_id, email}, {u_id, name, email, gender, age}, {name, email}, {name, gender} {...}

Candidate Key

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Super Key: {u_id}, {email}, {u_id, name}, {u_id, email}, {u_id, name, email, gender, age}, {name, email}, {name, gender} {...}

{u_id} = {}, {u_id}

{email} = {}, {email}

{u_id, name} = {}, {u_id}, {name}, {u_id, name}

{u_id, email} = {}, {u_id}, {email}, {u_id, email}

{name, gender} = {}, {name}, {gender}, {name, gender}

Candidate Key

User

u_id	name	email	gender	age
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Super Key: {u_id}, {email}, {u_id, name}, {u_id, email}, {u_id, name, email, gender, age}, {name, email}, {name, gender} {...}

{u_id} = {}, {u_id}

{email} = {}, {email}

{u_id, name} = {}, {u_id}, {name}, {u_id, name}

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{name, gender} = {}, {name}, {gender}, {name, gender}

Candidate Key

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{u_id, email} = {}, {u_id}, {email}, {u_id, email}

{name, gender} = {}, {name}, {gender}, {name, gender}

Candidate Key

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Super Key: {u_id}, {email}, {u_id, name}, {u_id, email}, {u_id, name, email, gender, age}, {name, email}, {name, gender} {...}

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{u_id, name} = {}, {u_id}, {name}, {u_id, name}

{u_id, email} = {}, {u_id}, {email}, {u_id, email}

{name, gender} = {}, {name}, {gender}, {name, gender}

Primary Key

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel24@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
5	Payel	payel@mail.com	male	45
6	Shifa	shifa@gmail.com	female	37

From the candidate keys, one key is chosen as the primary key for the table. The primary key is a specific candidate key that is selected as the main identifier for the records in that table

Should be unique, not null and stable

Candidate Key: {u_id}, {email}, {name, gender}

Primary Key

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel24@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
5	Payel	payel@mail.com	male	45
6	Shifa	shifa@gmail.com	female	37

From the candidate keys, one key is chosen as the primary key for the table. The primary key is a specific candidate key that is selected as the main identifier for the records in that table

Should be unique, not null and stable

Candidate Key: {u_id}, {email}, {name, gender}

Primary Key : {u_id}

Alternate Key

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel24@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
5	Payel	payel@mail.com	male	45
6	Shifa	shifa@gmail.com	female	37

Candidate keys which were not chosen as primary key

Candidate Key: {u_id}, {email}, {name, gender}

Primary Key : {u_id}

Composite Key

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
5	Payel	payel@mail.com	male	45
6	Shifa	shifa@gmail.com	female	37

A composite key is a candidate key that consists of two or more attributes together to uniquely identify a record in a table.

Candidate Key: {u_id}, {email}, {name, gender}

Primary Key : {u_id}

Alternate Key: {email}, {name, gender}

Composite Key

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
5	Payel	payel@mail.com	male	45
6	Shifa	shifa@gmail.com	female	37

A composite key is a candidate key that consists of two or more attributes together to uniquely identify a record in a table.

Candidate Key: {u_id}, {email}, {name, gender}

Primary Key : {u_id}

Alternate Key: {email}, {name, gender}

Composite key: {name, gender}

Simple Key

User

u_id	name	email	gender	age
1	Arish	arish@mail.com	male	15
2	Nuruddin	nour@mail.com	male	25
3	Payel	payel@gmail.com	female	32
4	Hassan	hassan@email.org	male	30
5	Payel	payel@mail.com	male	45
6	Shifa	shifa@gmail.com	female	37

A composite key is a candidate key that consists of two or more attributes together to uniquely identify a record in a table.

Candidate Key: {u_id}, {email}, {name, gender}

Primary Key : {u_id}

Alternate Key: {email}, {name, gender}

Composite key: {name, gender}

Simple key: {u_id}, {email}

Foreign Key

QUESTION

ANSWER

Foreign Key

CustomerID	Name	Email	Phone
1	Alice	alice@email.com	123-456-7890
2	Bob	bob@email.com	987-654-3210
3	Charlie	charlie@email.com	111-222-3333

Customer

Foreign Key

Primary Key

CustomerID	Name	Email	Phone
1	Alice	alice@email.com	123-456-7890
2	Bob	bob@email.com	987-654-3210
3	Charlie	charlie@email.com	111-222-3333

Customer

Foreign Key

Primary Key

CustomerID	Name	Email	Phone
1	Alice	alice@email.com	123-456-7890
2	Bob	bob@email.com	987-654-3210
3	Charlie	charlie@email.com	111-222-3333

Customer

OrderID	CustomerID	OrderDate	TotalAmount
101	1	2023-01-15	\$150
102	2	2023-01-16	\$200
103	1	2023-01-18	\$80

Order

Foreign Key

Primary Key

CustomerID	Name	Email	Phone
1	Alice	alice@email.com	123-456-7890
2	Bob	bob@email.com	987-654-3210
3	Charlie	charlie@email.com	111-222-3333

Customer

OrderID	CustomerID	OrderDate	TotalAmount
101	1	2023-01-15	\$150
102	2	2023-01-16	\$200
103	1	2023-01-18	\$80

Order



Foreign Key

Primary Key

CustomerID	Name	Email	Phone
1	Alice	alice@email.com	123-456-7890
2	Bob	bob@email.com	987-654-3210
3	Charlie	charlie@email.com	111-222-3333

Customer

Foreign Key

OrderID	CustomerID	OrderDate	TotalAmount
101	1	2023-01-15	\$150
102	2	2023-01-16	\$200
103	1	2023-01-18	\$80

Order

Foreign Key

A foreign key is an attribute in one table that refers to the primary key of another table, creating a relationship between the two tables.

CustomerID	Name	Email	Phone	OrderID	CustomerID	OrderDate	TotalAmount
1	Alice	alice@email.com	123-456-7890	101	1	2023-01-15	\$150
2	Bob	bob@email.com	654-321-9876	102	2	2023-01-16	\$200
3	Charlie	charlie@email.com	111-222-3333	103	1	2023-01-18	\$80

Customer

Order



Foreign Key

Primary Key

CustomerID	Name	Email	Phone
1	Alice	alice@email.com	123-456-7890
2	Bob	bob@email.com	987-654-3210
3	Charlie	charlie@email.com	111-222-3333

Customer

END

Foreign Key

OrderID	CustomerID	OrderDate	TotalAmount
101	1	2023-01-15	\$150
102	2	2023-01-16	\$200
103	1	2023-01-18	\$80

Order



Database Design

SDLC

Database Design

SDLC

Planning

Analysis

System Design

Database Design

SDLC

Planning

Building

Analysis

Testing

System Design

Deployment

Database Design

System Design

Purpose of Database design:

Structured organization for efficient data management and retrieval

Database Design



EduHub is a global website offering a variety of technology courses across different subjects, allowing students to enroll and learn

Database Design

EduHub is a global website offering a variety of technology courses across different subjects, allowing students to enroll and learn



Database Design

Next Level Dev



EduHub is a global website offering a variety of technology courses across different subjects, allowing students to enroll and learn



- Students Enrolling in Courses:
- Courses Available for Enrollment:
- Instructors taking courses

Database Design

id	name	email	phone

id	name	email

Database Design

id	name	email	phone

id	name	email

Determining Entities

Determining Attributes For Each Entities

Relationships Among Entities

Resolving Many to Many Relationship

Determining Entities

- Students Enrolling in Courses:
- Courses Available for Enrollment:
- Instructors taking courses

Database Design

Determining Entities

- Students Enrolling in Courses:
- Courses Available for Enrollment:
- Instructors taking courses

students

courses

instructors

Database Design

id	name	email	phone

id	name	email

Determining Entities

Determining Attributes For Each Entities

Relationships Among Entities

Resolving Many to Many Relationship

Database Design

Determining Attributes

students

courses

instructors

Database Design

Determining Attributes

students

student_id **name** **email**

courses

instructors

Database Design

Determining Attributes

students

student_id **name** **email**

courses

course_id **c_name** **instructor_id**

instructors

Database Design

Determining Attributes

students

student_id **name** **email**

courses

course_id **c_name** **instructor_id**

instructors

instructor_id **i_name** **gender**

Database Design

id	name	email	phone

id	name	email

Determining Entities

Determining Attributes For Each Entities

Relationships Among Entities

Resolving Many to Many Relationship

Relationship Among Entities

Relationship Among Entities

Relationship Cardinality

Relationship Among Entities

Relationship Cardinality

Relationship cardinality is the rule that defines how many instances of one entity can be associated with instances of another entity in a database.

Relationship Cardinality

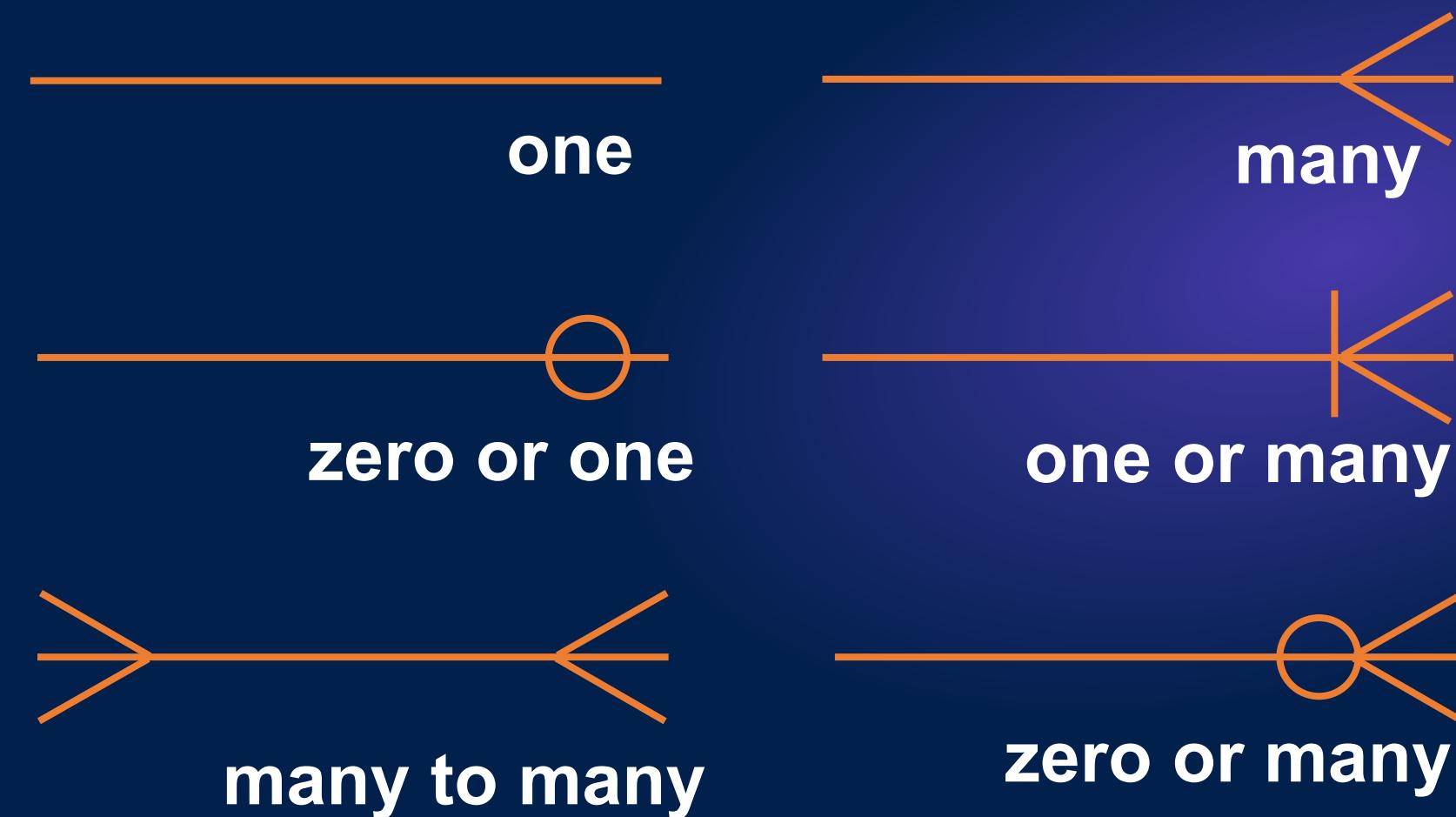
One-to-One (1:1)

One-to-Many (1:N)

Many-to-One (N:1)

Many-to-Many (N:N)

Relationship Cardinality Signs



Entity-Relationship (ER) diagram

Entity-Relationship (ER) diagram

ER diagram is a diagram that shows entities, their attributes, and the relationships between them.