Data Storage & Infrastructure

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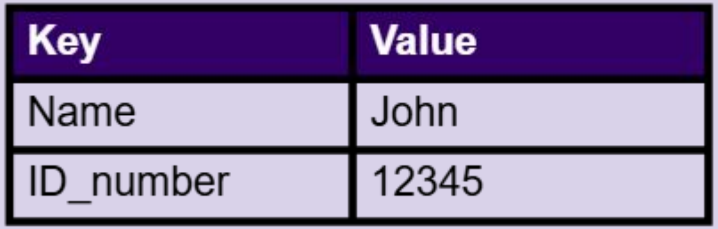
Relational Database Systems

STRUCTURED

- Data stored in tables
- Not difficult to analyze

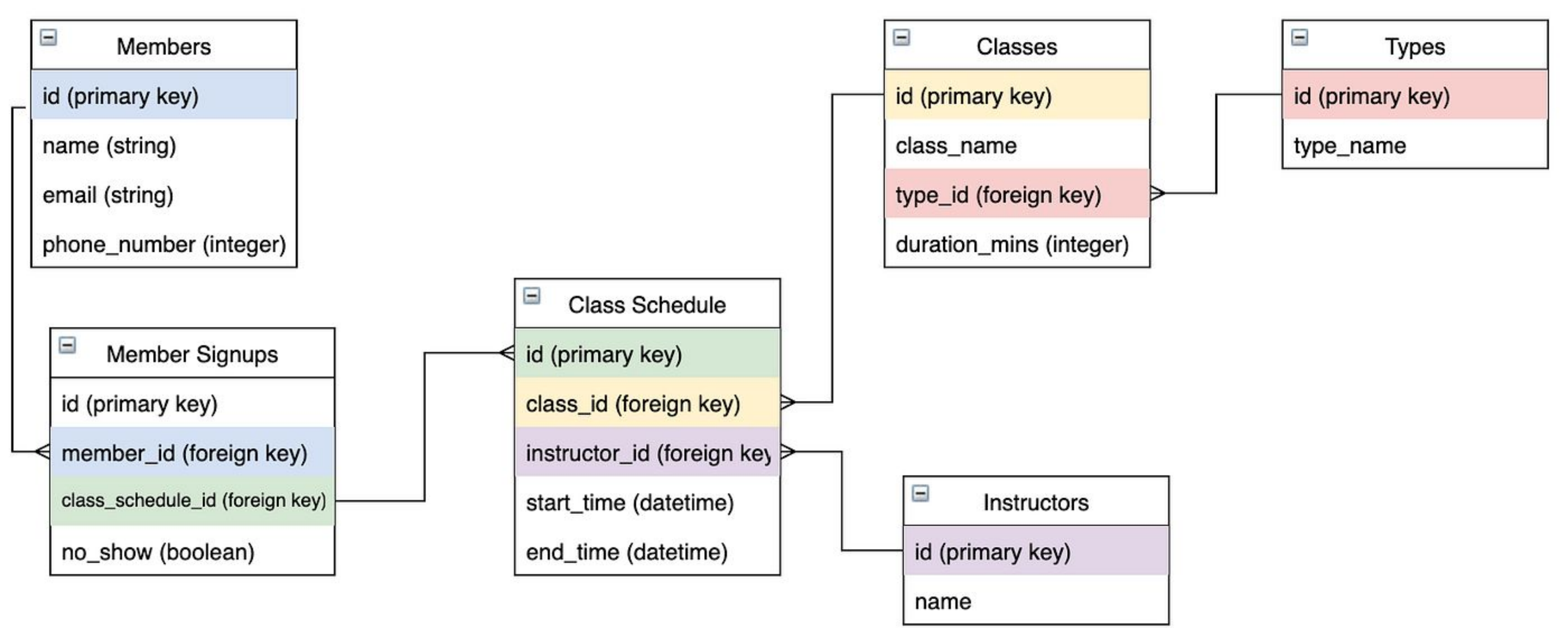
A relational database system follows a more rigid, structured model.

The database is fractured into various tables with an identifying key which defines data elements and their relationships to each other.



Key	Value
Name	John
ID_number	12345

Relational Database Systems



Members
- id (primary key)
- name (string)
- email (string)
- phone_number (integer)

Member Signups
- id (primary key)
- member_id (foreign key)
- class_schedule_id (foreign key)
- no_show (boolean)

Class Schedule
- id (primary key)
- class_id (foreign key)
- instructor_id (foreign key
- start_time (datetime)
- end_time (datetime)

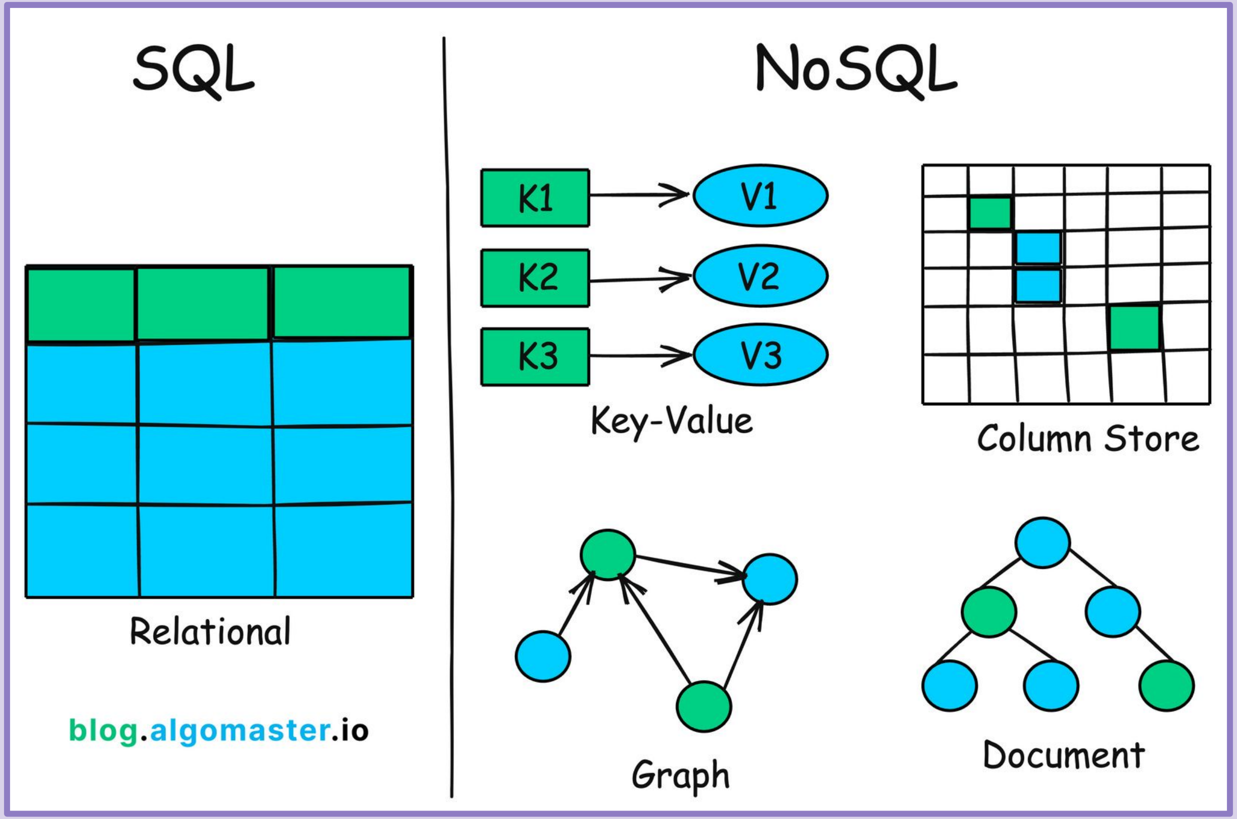
Classes
- id (primary key)
- class_name
- type_id (foreign key)
- duration_mins (integer)

Types
- id (primary key)
- type_name

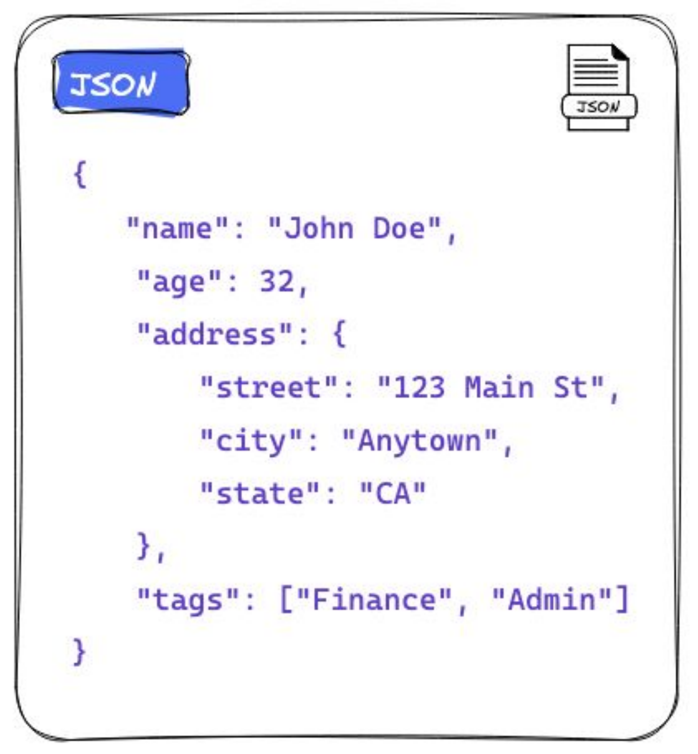
Instructors
- id (primary key)
- name

MYSQL & Postgre

SQL VS NoSQL


SQL
NoSQL
K1
V1
K2
V2
K3
V3
Key-Value
Column Store
Relational
Graph
Document
blog.algomaster.io

Document-oriented databases



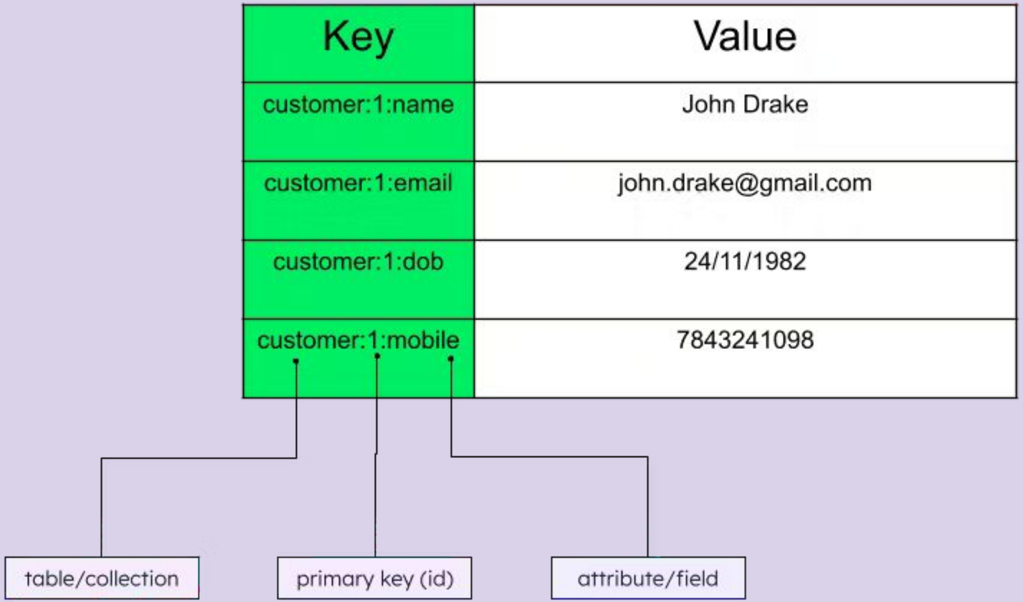
```
{
   "name": "John Doe",
    "age": 32,
    "address": {
        "street": "123 Main St",
        "city": "Anytown",
        "state": "CA"
    },
    "tags": ["Finance", "Admin"]
}
```

mongoDB®

Couchbase

Key Value

Key value database storage



Key	Value
customer:1:name	John Drake
customer:1:email	john.drake@gmail.com
customer:1:dob	24/11/1982
customer:1:mobile	7843241098

table/collection

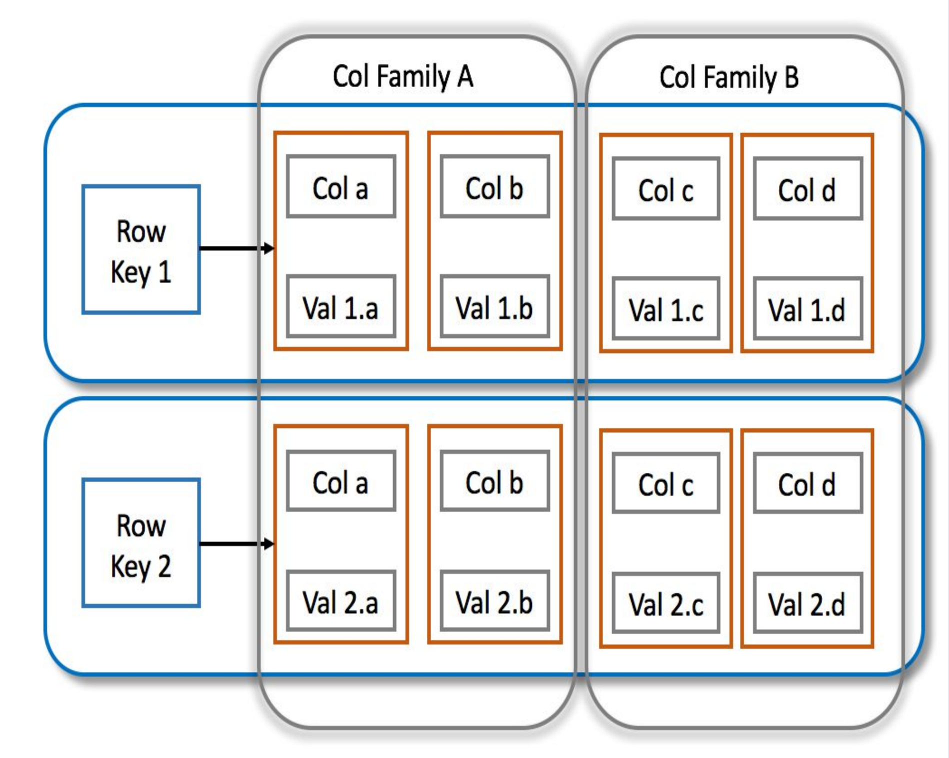
primary key (id)

attribute/field

Amazon DynamoDB

redis

Wide-column stores



Col Family A

Col Family B

Row Key 1

Col a

Val 1.a

Col b

Val 1.b

Col c

Val 1.c

Col d

Val 1.d

Row Key 2

Col a

Val 2.a

Col b

Val 2.b

Col c

Val 2.c

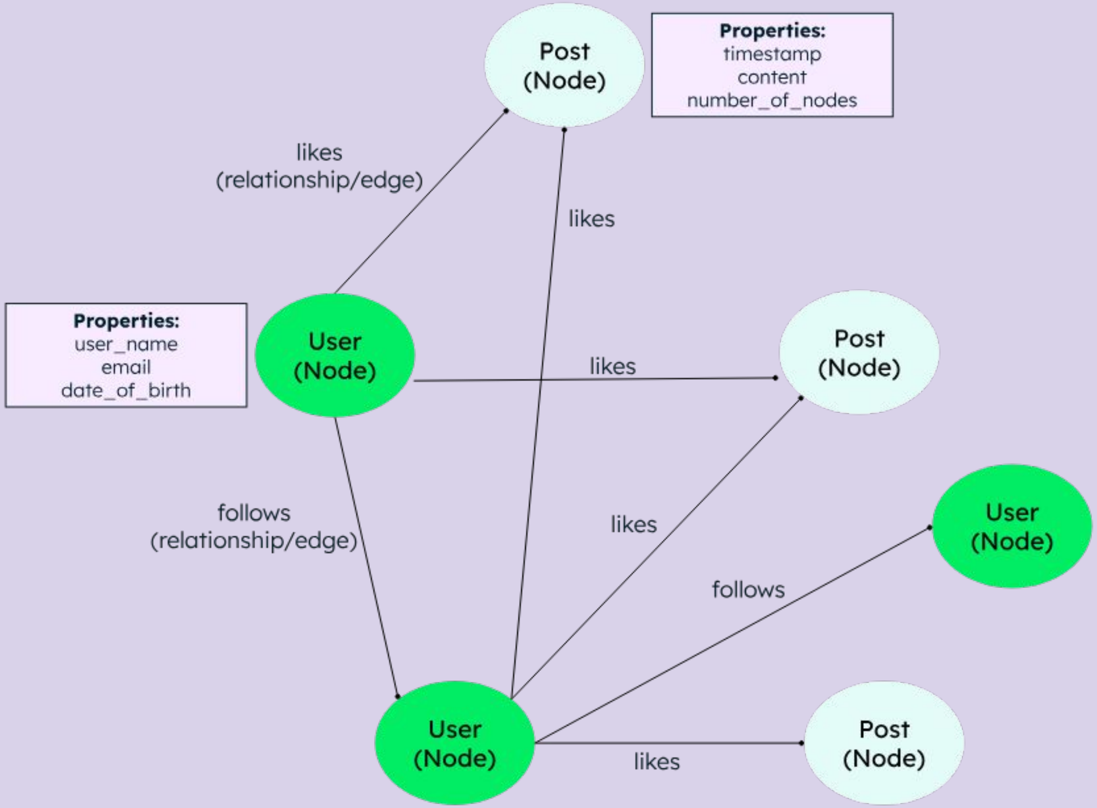
Col d

Val 2.d

Apache CASSANDRA

APACHE HBASE

Graph databases

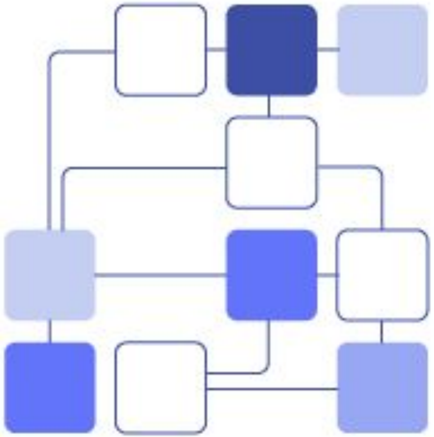


neo4j

Amazon Neptune

NoSQL

Unstructured



Dynamic schema

Non relational model

Horizontally scalable

Suited for hierarchical data storage

Which Database to Use & When

Relational Databases (SQL)

- Examples: MySQL, PostgreSQL, Oracle, SQL Server

NoSQL Databases

- Examples: MongoDB, CouchDB (JSON-like documents)

Relational Databases (SQL)

- Use for structured data with predictable schemas, like customer records or financial transactions. Ideal for complex queries, reporting, or apps needing strong consistency

NoSQL Databases

- Use for unstructured or semi-structured data, rapid scaling, or flexible schemas. Choose document stores (MongoDB) for content management, key-value (Redis) for caching, column-family (Cassandra) for big data

Elasticsearch & Cassandra

elasticsearch

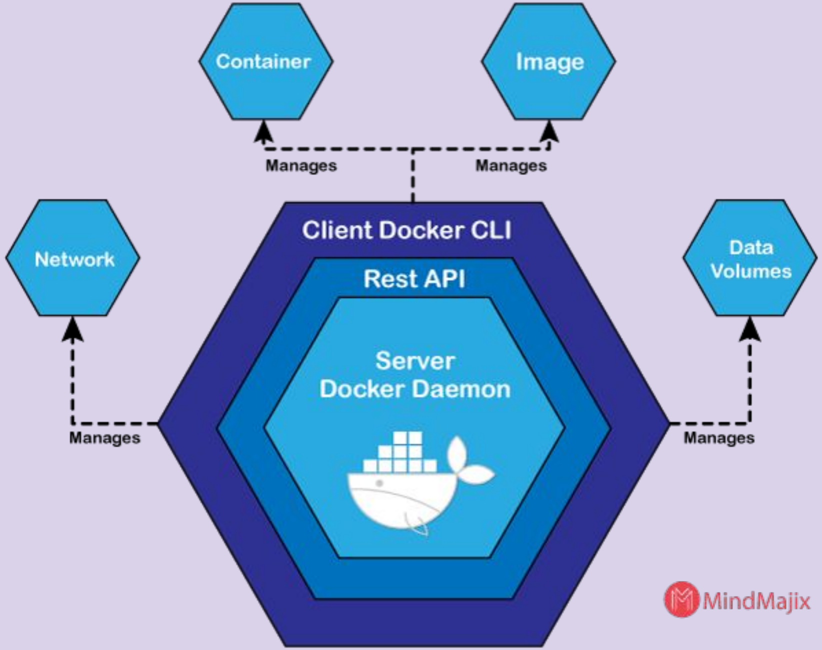
- Full-text search & real-time analytics
- JSON-based, automatically indexed data
- Part of ELK stack (Logstash, Kibana)

cassandra

- Distributed, column-based NoSQL database
- Built for scalability & uptime
- Handles massive data across servers

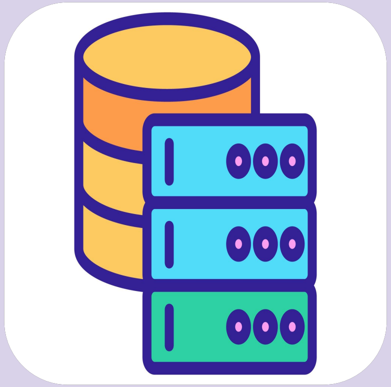
What is Docker?

A platform for developing, packaging, and running applications inside containers



What are the uses for Docker?

Collaboration & Team Development



Connecting Databases

Flexibility

Containers

How to Create a Container, push and pull an Image(MySQL)

1 **Create a Container:** docker run --name containerName -e MYSQL_ROOT_PASSWORD=password -p 3306:3306 -d mysql

2 **Make edits to container:** CREATE DATABASE project; USE project; CREATE TABLE students (id INT…);

3 **Make a repository:** Got to https://hub.docker.com and create a repository and give it a name.

4 **Build & Tage the Image:** docker build -t yourUserName/repoName:tagName .

5 **Push to repository in Docker Hub:** docker push yourUserName/repoName:tagName

6 **Pull image:** docker pull yourUserName/repoName:tagName

7 **Run a container on pulled image:** docker run --name teammate -e MYSQL_ROOT_PASSWORD=password -p 3306:3306 -d yourUserName/repoName:tagName

This only initializes the databases. Any changes will have to be shared through dumps.