UNIT 1 : CONCEPTS OF NOSQL : MONGODB

1.1 Concepts of NoSQL. Advantages and Features

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1.1 Concepts of NoSQL. Advantages and Features

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1.1.2 Database Creation and Dropping Database

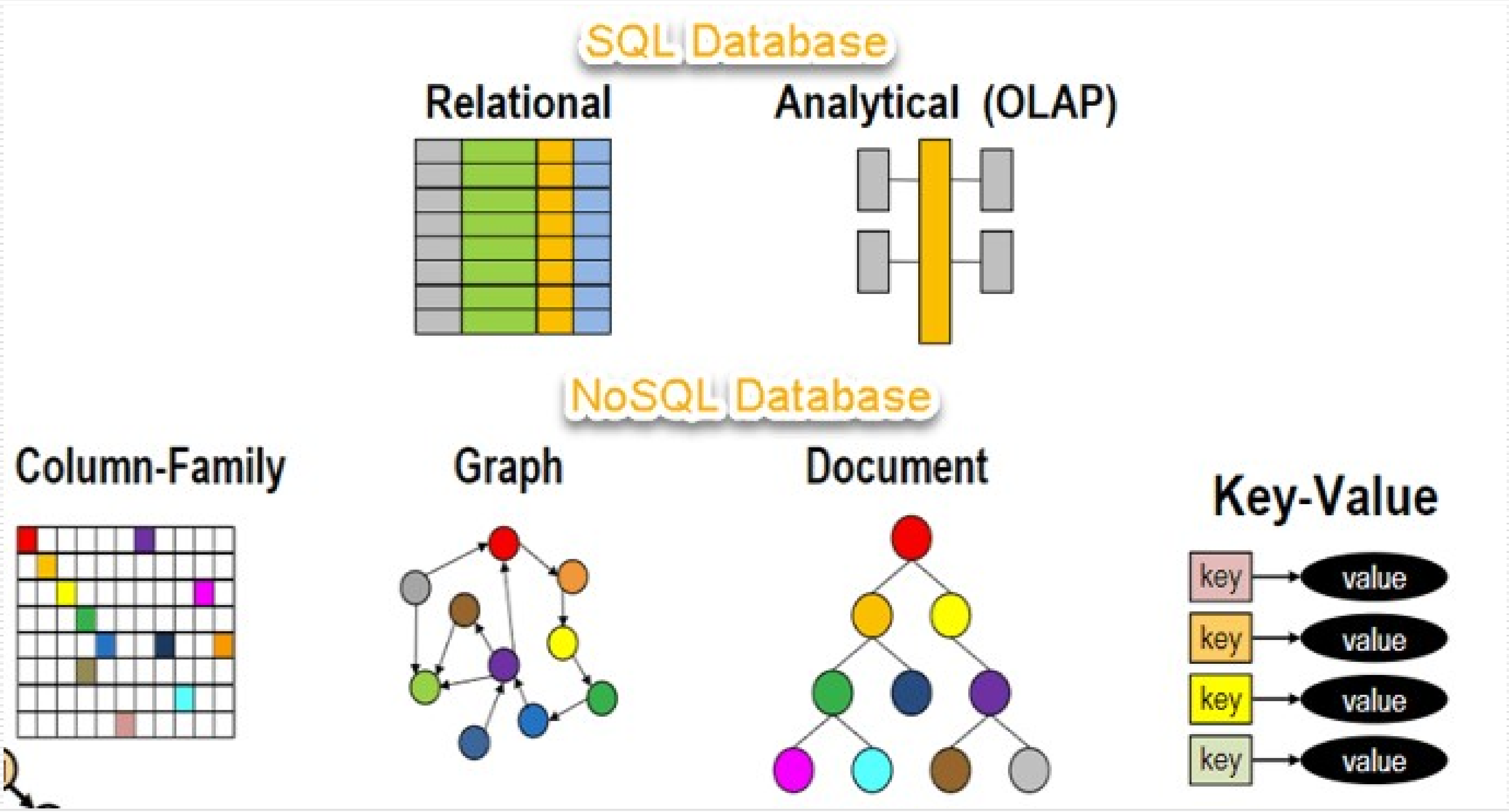
Introduction

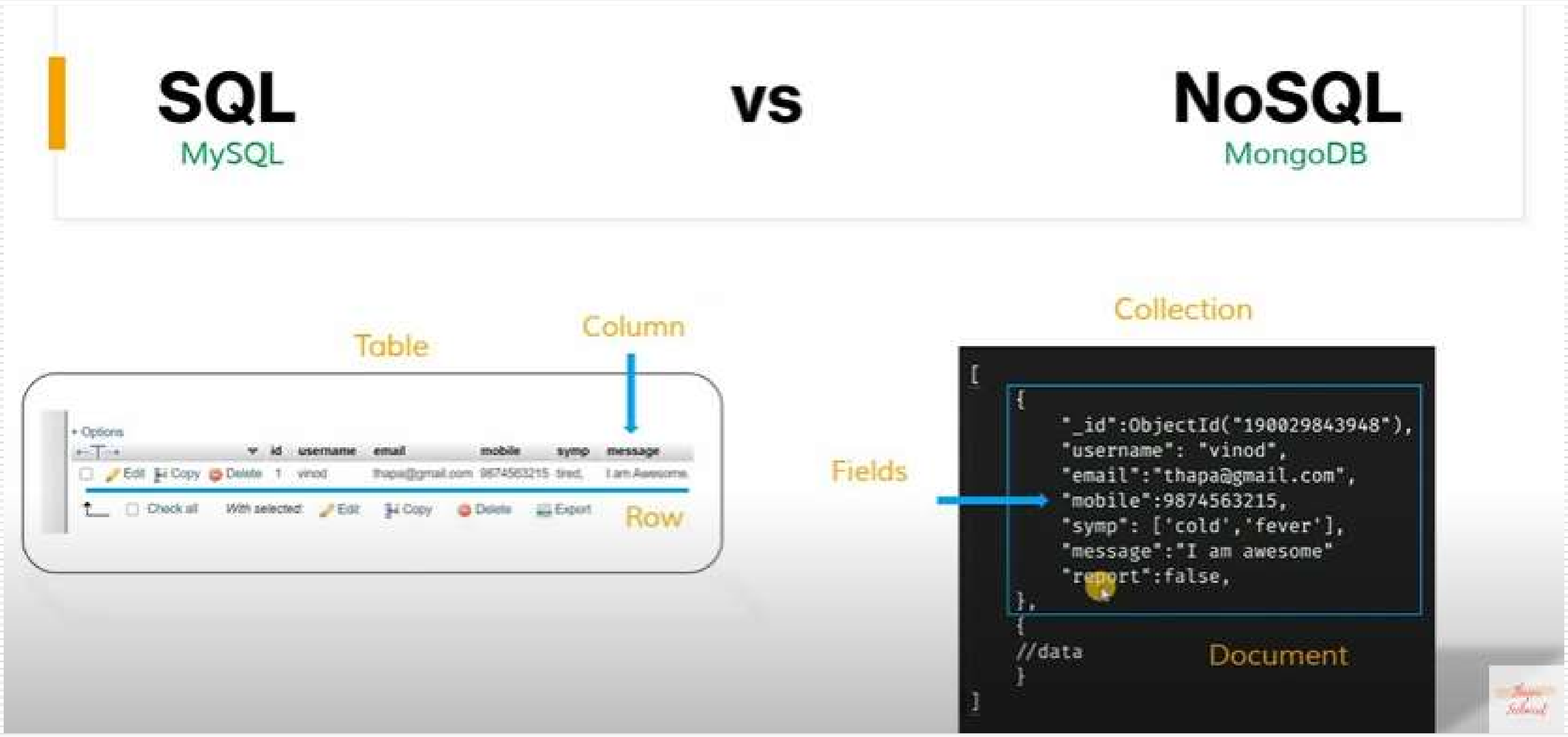
- A **NoSQL (Not Only SQL or Not SQL)** originally referring to **non SQL** or **non relational** is a database that provides a mechanism for storage and retrieval of data.
- This data is **modeled**, it means other than the **tabular relations** used in relational databases.
- **NoSQL are non-tabular databases and store data differently than relational tables**. NoSQL databases come in a variety of types based on their data model. The main types are document, key-value, wide-column, and graph.

- **Carl Strozzi** introduced the NoSQL concept in **1998**.
- Traditional RDBMS uses SQL syntax to store and retrieve data for further insights. Instead, a NoSQL database system encompasses a wide range of database technologies that can store structured, semi-structured, unstructured and polymorphic data.

Models of NOSQL Database

- Key-Value pair-based databases.
- Column-based databases.
- Document-oriented databases.
- Graph databases.


SQL Database
Relational
Analytical (OLAP)
NoSQL Database
Column-Family
Graph
Document
Key-Value
key
value
key
value
key
value
key
value



SQL vs NoSQL

MySQL

MongoDB

	id	username	email	mobile	symp	message
Edit Copy Delete	1	vinod	thapa@gmail.com	9874563215	tired,	I am Awesome

```
[
  {
      "_id":ObjectId("190029843948"),
      "username": "vinod",
      "email":"thapa@gmail.com",
      "mobile":9874563215,
      "symp": ['cold','fever'],
      "message":"I am awesome"
      "report":false,
  },
  {
  //data
  }
]
```

- The concept of NoSQL databases became popular with **Internet giants like Google, Facebook, Amazon,** etc. who deal with **huge volumes of data**. The system response time becomes slow when you use RDBMS for massive volumes of data.
- To resolve this problem, we could "**scale up**" our systems by upgrading our existing hardware. This process is expensive.

History

- 1998- Carlo Strozzi use the term NoSQL for his lightweight, open-source relational database
- 2000- Graph database Neo4j is launched
- 2004- Google BigTable is launched
- 2005- CouchDB is launched
- 2007- The research paper on Amazon Dynamo is released
- 2008- Facebooks open sources the Cassandra project
- 2009- The term NoSQL was reintroduced

Advantages & Features

1. Support for Multiple Data Models
2. Easily Scalable via Peer-to-Peer Architecture
3. Flexibility: Versatile Data Handling
4. Distribution Capabilities
5. Zero Downtime

1. Support for Multiple Data Models

- Where **relational databases require data to be put into tables and columns** to be accessed and analyzed, the **various data model capabilities of NoSQL databases make them extremely flexible** when it comes to handling data.
- They can ingest **structured, semi-structured, and unstructured data** with equal ease, whereas relational databases are **extremely rigid, handling primarily** structured data.
- Developers and architects **choose a NoSQL database to more easily handle different agile application** development requirements.

2. Easily Scalable via Peer-to-Peer Architecture

- It's not that **Relational Database can't scale**, it's that they can't scale EASILY or CHEAPLY, and that's because they're built with a traditional **master-slave architecture**, which means scaling UP via bigger and bigger hardware servers as opposed to OUT or worse via sharding.
- **Sharding means dividing a database into smaller chunks across multiple hardware servers** instead of a single large server, and this leads to operational administration headaches. Instead, look for a NoSQL database with a masterless, peer-to-peer architecture with all nodes being the same.

3. Flexibility: Versatile Data Handling

- Where relational databases require data to be put into **tables and columns** to be accessed and analyzed, the multi-model capabilities of NoSQL databases make them **extremely flexible** when it comes to handling data.
- They can **easily process structured, semi-structured, and unstructured data**, while relational databases, are **designed to handle primarily structured data**.

4. Distribution Capabilities

- Look for a NoSQL database that is **designed to distribute data at global scale**, meaning it can use **multiple locations** involving multiple data centers and/or cloud regions for write and read operations. Relational databases, in contrast, use a centralized application that is location-dependent (e.g. single location), especially for write operations.
- A key advantage of using a distributed database with a masterless architecture is that you can **maintain continuous availability** because data is distributed with multiple copies where it needs to be.

5. Zero Downtime

- The final but certainly no less important key feature to seek in a NoSQL database is zero downtime. This is made possible by a **masterless architecture**, which allows for multiple copies of data to be **maintained across different nodes**.
- **If a node goes down, no problem: another node has a copy of the data for easy, fast access.** When one considers the cost of downtime, this is a big deal.

MongoDB

- MongoDB, the **most popular NoSQL database**, is an **open-source document-oriented database**. The term ‘NoSQL’ means ‘non-relational’. It means that **MongoDB isn’t** based on the **table-like relational database** structure but provides an all together different mechanism for **storage and retrieval** of data. This format of storage is called **BSON** (similar to JSON format).

- SQL databases store data in **tabular format**. This data is stored in a **predefined data model which is not very much flexible for today's real-world highly growing applications**. Modern applications are **more networked**, **social** and **interactive** than ever. Applications are storing more and more data and are accessing it at higher rates.

Download Link for MongoDB

- SHELL
  - https://downloads.mongodb.com/compass/mongosh-1.4.2-x64.msi
- UI
  - https://fastdl.mongodb.org/windows/mongodb-windows-x86_64-5.0.8-signed.msi
  - https://fastdl.mongodb.org/windows/mongodb-windows-x86_64-5.0.9-signed.msi

1.1.1 MongoDB Data Types

- String
- Integer
- Boolean
- Double
- Arrays
- Objects

- **String** – This is the most commonly used datatype to store the data. String in MongoDB must be UTF-8 valid.

- **Integer** – This type is used to store a numerical value. Integer can be 32 bit or 64 bit depending upon your server.
- **Boolean** – This type is used to store a boolean (true/ false) value.
- **Double** – This type is used to store floating point values.

- **Arrays** – This type is used to store arrays or list or multiple values into one key.
- **Object** – This datatype is used for embedded documents.

SQL	**NOSQL**
DATABASE	DATABASE
TABLES	COLLECTION
ROWS	DOCUMENTS
COLUMNS	FIELDS

1.1.2 Database Creation and Dropping Database

- To Show all Databases
  - show dbs;
- To create new Database
  - use db_name;
  - To create a new database. If database does not exist it will create new database, if database exist then it will switch to particular database.

- To Drop Database
  - db.dropDatabase()
  - To drop database first use the database which you want to drop.
- To check current database
  - db

Collection

- A collection is **a grouping of MongoDB documents**.
- Documents within a collection can have **different fields**.
- A collection is the **equivalent** of a **table** in a relational database system.
- A **collection exists within a single** database.

1.2 Create and Drop Collection

- Create Collection
  - db.createCollection(name,option)
- Drop Collection
  - db.collection_name.drop()

Example:

- db.createCollection("emp_mst");
- db.emp_mst.insert({name:"Hardik Pandya",age:28,type:"All Rounder"});
- db.emp_mst.find();
- db.emp_mst.find().pretty();
- db.emp_mst.drop();

1.3 CRUD Operations

- Insert
- Update
- Delete
- Find
- Query
- Projection Operators

insert()

- To insert document in collection use insert() method.

```
db.collection.insert(
{
    Field1 : value1,
    Filed2 : value2
    ....
}
)
```

Example:

- db.stud.insert({"name":“Rohit","type":"All Rounder","age":33});

update()

- MongoDB's **update()** and **save()** methods are used to update document into a collection. The update() method updates the values in the existing document while the save() method replaces the existing document with the document passed in save() method.

```
db.staff.update(
    {‘field’:’value’},
    {$set:{field:’newvalue’}
    }
    )
```

Example:

- db.stud.update({"age":35},{$set:{ age:33}})

delete

- MongoDB's **remove()** method is used to remove a document from the collection. remove() method accepts two parameters. One is deletion criteria and second is justOne flag.
- **deletion criteria** – (Optional) deletion criteria according to documents will be removed.
- **justOne** – (Optional) if set to true or 1, then remove only one document.
- Syntax:
  - db.COLLECTION_NAME.remove(DELLETION_CRITTERIA)

Example:

- db.stud.remove({"age":33})

find()

- Syntax:
  - db.COLLECTION_NAME.find({},{KEY:1})

Query Operators

- **Comparison**
- **Logical**
- **Element**
- **Evaluation**
- **Array**
- **Bitwise**

Comparison

Name	Description
$eq	Matches values that are equal to a specified value.
$gt	Matches values that are greater than a specified value.
$gte	Matches values that are greater than or equal to a specified value.
$in	Matches any of the values specified in an array.
$lt	Matches values that are less than a specified value.
$lte	Matches values that are less than or equal to a specified value.
$ne	Matches all values that are not equal to a specified value.
$nin	Matches none of the values specified in an array.

- db.stud.find({age:{$eq:32}}).pretty();
- db.stud_mst.find({stud_id:{$gte:2}}).pretty();
- db.stud_mst.find({stud_id:{$in:[1 , 2]}}).pretty();
- db.stud_mst.find({stud_id:{$ne:2}}).pretty();

Logical

Name	Description
$and	Joins query clauses with a logical AND returns all documents that match the conditions of both clauses.
$not	Inverts the effect of a query expression and returns documents that do *not* match the query expression.
$nor	Joins query clauses with a logical NOR returns all documents that fail to match both clauses.
$or	Joins query clauses with a logical OR returns all documents that match the conditions of either clause.

Example:

- db.stud_mst.find({$and:[{stud_fname:{$eq:"Akshay"}},{stud_lname:{$eq:"Kumar"}}]}).pretty()
- db.stud_mst.find({$or:[{stud_fname:{$eq:"Akshay"}},{stud_lname:{$eq:"Sharma"}}]}).pretty()
- db.stud_mst.find({$nor:[{stud_fname:{$eq:"Akshay"}},{stud_lname:{$eq:"Sharma"}}]}).pretty()

Element

Name	Description
$exists	Matches documents that have the specified field.
$type	Selects documents if a field is of the specified type.

Evaluation

Name	Description
$expr	Allows use of aggregation expressions within the query language.
$jsonSchema	Validate documents against the given JSON Schema.
$mod	Performs a modulo operation on the value of a field and selects documents with a specified result.
$regex	Selects documents where values match a specified regular expression.
$text	Performs text search.
$where	Matches documents that satisfy a JavaScript expression.

Array

Name	Description
$all	Matches arrays that contain all elements specified in the query.
$elemMatch	Selects documents if element in the array field matches all the specified $elemMatch conditions.
$size	Selects documents if the array field is a specified size.

Bitwise

Name	Description
$bitsAllClear	Matches numeric or binary values in which a set of bit positions *all* have a value of 0.
$bitsAllSet	Matches numeric or binary values in which a set of bit positions *all* have a value of 1.
$bitsAnyClear	Matches numeric or binary values in which *any* bit from a set of bit positions has a value of 0.
$bitsAnySet	Matches numeric or binary values in which *any* bit from a set of bit positions has a value of 1.

1.4 Operators

- Projections
- Update()
- Limit()
- sort()
- Aggregation Commands

Projection

- In MongoDB, projection means selecting only the necessary data rather than selecting whole of the data of a document. If a document has 5 fields and you need to show only 3, then select only 3 fields from them.

Name	Description
$	Projects the first element in an array that matches the query condition.
$elemMatch	Projects the first element in an array that matches the specified $elemMatch condition.
$meta	Projects the document's score assigned during $text operation.
$slice	Limits the number of elements projected from an array. Supports skip and limit slices.

- To Display all documents
  - db.collection.find()
- To display all documents in pretty format
  - db.collection.find().pretty()
- To display specific data
  - db.collection.find({field:’value’})

- To remove id field
  - **db.emp_mst.find({},{_id:0});**

Update

- Same as discussed in CRUD Operation

Limit()

- To limit the records in MongoDB, you need to use **limit()** method. The method accepts one number type argument, which is the number of documents that you want to be displayed.
- Syntax : db.COLLECTION_NAME.find().limit(NUMBER)

Example:

```
db.stud.find().pretty().limit(1);
```

sort()

- To sort documents in MongoDB, you need to use **sort()** method. The method accepts a document containing a list of fields along with their sorting order. To specify sorting order 1 and -1 are used. 1 is used for ascending order while -1 is used for descending order.
- Syntax:

```
db.COLLECTION_NAME.find().sort({KEY:1})
```

Example:

- db.staff.find().sort({name:1}).pretty()

Aggregation Commands

- Aggregations operations process data records and return computed results.
- Aggregation operations group values from multiple documents together, and can perform a variety of operations on the grouped data to return a single result.
- In SQL count(*) and with group by is an equivalent of MongoDB aggregation.
- Syntax: db.COLLECTION_NAME.aggregate(AGGREGATE_OPERATION)

Name	Description
aggregate	Performs aggregation tasks such as $group using an aggregation pipeline.
count	Counts the number of documents in a collection or a view.
distinct	Displays the distinct values found for a specified key in a collection or a view.

Example:

- db.stud.aggregate([{$count:"myCount"}])
- db.runCommand({distinct:"stud",key:"name"});