

Experiment 10

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Aim:

To study and perform basic CRUD (Create, Read, Update, Delete) operations in **MongoDB**, a NoSQL document-based database, and understand its key commands, such as creating databases, collections, inserting, updating, deleting records, and grouping data using aggregation.

Objective:

- To understand the concept of NoSQL and document-based databases.
- To learn how to create and manage databases and collections in MongoDB.
- To perform CRUD operations — Create, Read, Update, and Delete — on MongoDB collections.
- To use operators like \$push, \$pull, \$unset, and \$insert for document updates.
- To execute conditional queries and retrieve nested document data using find().
- To perform grouping and aggregation operations using \$sum and other aggregation operators.
- To compare SQL and NoSQL databases in terms of structure, performance, and use cases.
- To apply MongoDB commands on a practical dataset (e.g., car dealership data) for hands-on understanding.

Theory:

MongoDB is a NoSQL document-oriented database that stores data in JSON-like documents instead of tables and rows. It is designed for handling large, unstructured, or semi-structured data with flexibility and scalability.

A **MongoDB database** contains **collections**, and each collection holds multiple **documents** made up of key-value pairs. Unlike SQL databases, MongoDB allows documents in the same collection to have different structures, making it ideal for applications with changing data requirements.

Basic Operations:

- **Create:** use `db_name`, `db.createCollection()`
- **Insert:** `insertOne()`, `insertMany()`
- **Read:** `find()`, `findOne()`
- **Update:** `updateOne()`, `updateMany()` with `$set`, `$push`, `$pull`, `$upsert`
- **Delete:** `deleteOne()`, `deleteMany()`

MongoDB also supports **aggregation** (e.g., `$sum`, `$group`) for analyzing and summarizing data.

Advantages:

- Flexible and schema-less structure
- High performance and scalability
- Easy integration with modern applications

In short, MongoDB is preferred for applications requiring **speed, flexibility, and scalability**, while SQL remains suited for **structured and relational data**.

Procedure:

- Start the MongoDB server and open the Mongo shell or MongoDB Compass.
- Create or switch to a new database.
- Create a new collection to store data.
- Insert one or more documents into the collection.
- Retrieve data from the collection using read operations.
- Apply filters or conditions to view specific data.
- Update existing records in the collection as required.
- Delete one or multiple records from the collection.
- Perform grouping or aggregation operations to analyze data.
- Drop collections or the entire database if no longer needed.

Code:

```
db.createCollection("cars")
```

```
db.cars.insertOne({
```

```
  "maker": "Tata",
```

```
  "model": "Nexon",
```

```
  "fuel_type": "Petrol",
```

```
  "transmission": "Automatic",
```

```
  "engine": {
```

```
    "type": "Turbocharged",
```

```
    "cc": 1199,
```

```
    "torque": "170 Nm"
```

```
  },
```

```
  "features": [
```

```
    "Touchscreen",
```

```
    "Reverse Camera",
```

```
    "Bluetooth Connectivity"
```

```
  ],
```

```
  "sunroof": false,
```

```
  "airbags": 2
```

```
})
```

```
db.cars.find().pretty()
```

```
db.cars.insertMany([{"maker": "Tata", "model": "Nexon", "fuel_type": "Petrol", "transmission": "Automatic", "engine": {"type": "Turbocharged", "cc": 1199, "torque": "170 Nm"}, "features": ["Touchscreen", "Reverse Camera", "Bluetooth Connectivity"], "sunroof": false, "airbags": 2}, {"maker": "Hyundai", "model": "Creta", "fuel_type": "Diesel", "transmission": "Manual", "engine": {"type": "CRDi", "cc": 1493, "torque": "250 Nm"}, "features": ["Sunroof", "ABS", "Touchscreen"], "sunroof": true, "airbags": 6}, {"maker": "Maruti", "model": "Swift", "fuel_type": "Petrol", "transmission": "Manual", "engine": {"type": "Naturally Aspirated", "cc": 1197, "torque": "113 Nm"}, "features": ["Bluetooth Connectivity", "Power Windows"], "sunroof": false, "airbags": 2}])
```

```
db.cars.find()
```

```
db.cars.findOne()
```

```
db.cars.find({}, { model: 1, _id: 0 })
```

```
db.cars.find({ "fuel_type": "Petrol" })
```

```
db.cars.updateOne(
```

```
  { model: "Nexon" },
```

```
  { $set: { color: "Red" } }  
)
```

```
db.cars.find({ model: "Nexon" }).pretty()
```

```
db.cars.updateOne(
```

```
  { model: "Nexon" },
```

```
  { $push: { features: "Heated Seats" } }  
)
```

```
db.cars.find({ model: "Nexon" }).pretty()
```

```
db.cars.updateOne(
```

```
  { model: "Nexon" },
```

```
  { $pull: { features: "Heated Seats" } }  
)
```

```
db.cars.find({ model: "Nexon" }).pretty()
```

```
db.cars.updateMany(
```

```
  { fuel_type: "Diesel" },
```

```
  { $set: { alloys: "yes" } }  
)
```

```
db.cars.find({ fuel_type: "Diesel" }).pretty()
```

```
db.cars.updateOne(
```

```
  { model: "Nexon" },
```

```
    { $push: { features: { $each: ["Wireless charging", "Voice Control"] } } }
```

```
)
```

```
db.cars.find({ model: "Nexon" }).pretty()
```

```
db.cars.updateOne(
```

```
  { model: "Nexon" },
```

```
  { $unset: { color: "" } }
```

```
)
```

```
db.cars.find({ model: "Nexon" }).pretty()
```

```
db.cars.aggregate([
```

```
{
```

```
  $group: {
```

```
    _id: "$maker",
```

```
    TotalCars: { $sum: 1 }
```

```
  }
```

```
}
```

```
])
```

```
db.cars.aggregate([
```

```
{
```

```
  $group: {
```

```
    _id: "$fuel_type",
```

```
    TotalCars: { $sum: 1 }
```

```
  }
```

```
}
```

```
])
```

Output:

```
test> db.createCollection("cars")
{ ok: 1 }
test> db.cars
test.cars
test> {
...   "maker": "Tata",
...   "model": "Nexon",
...   "fuel_type": "Petrol",
...   "transmission": "Automatic",
...   "engine": {
...     "type": "Turbocharged",
...     "cc": 1199,
...     "torque": "170 Nm"
...   },
...   "features": [
...     "Touchscreen",
...     "Reverse Camera",
...     "Bluetooth Connectivity"
...   ],
...   "sunroof": false,
...   "airbags": 2
... }
...
...
```

```
test> db.cars.insertOne(
... {
...   "maker": "Tata",
...   "model": "Nexon",
...   "fuel_type": "Petrol",
...   "transmission": "Automatic",
...   "engine": {
...     "type": "Turbocharged",
...     "cc": 1199,
...     "torque": "170 Nm"
...   },
...   "features": [
...     "Touchscreen",
...     "Reverse Camera",
...     "Bluetooth Connectivity"
...   ],
...   "sunroof": false,
...   "airbags": 2
... })
{
  acknowledged: true,
  insertedId: ObjectId('690a31c2d72ea166af63b112')
}
```

```
test> db.cars.insertMany(
... [
... {
...   "maker": "Hyundai",
...   "model": "Creta",
...   "fuel_type": "Diesel",
...   "transmission": "Manual",
...   "engine": {
...     "type": "Naturally Aspirated",
...     "cc": 1493,
...     "torque": "250 Nm"
...   },
...   "features": [
...     "Sunroof",
...     "Leather Seats",
...     "Wireless Charging",
...     "Ventilated Seats",
...     "Bluetooth"
...   ],
...   "sunroof": true,
...   "airbags": 6
... },
... {
...   "maker": "Maruti Suzuki",
...   "model": "Baleno",
...   "fuel_type": "Petrol",
...   "transmission": "Automatic",
...   "engine": {
...     "type": "Naturally Aspirated",
...     "cc": 1197,
...     "torque": "113 Nm"
...   },
...   "features": [
...     "Projector Headlamps",
...     "Apple CarPlay",
...     "ABS"
...   ],
...   "sunroof": false,
...   "airbags": 2
... }
```



```
{
  acknowledged: true,
  insertedIds: {
    '0': ObjectId('690a31e6d72ea166af63b113'),
    '1': ObjectId('690a31e6d72ea166af63b114'),
    '2': ObjectId('690a31e6d72ea166af63b115'),
    '3': ObjectId('690a31e6d72ea166af63b116')
  }
}
```

```
test> db.cars.find()
[
  {
    _id: ObjectId('690a31c2d72ea166af63b112'),
    maker: 'Tata',
    model: 'Nexon',
    fuel_type: 'Petrol',
    transmission: 'Automatic',
    engine: { type: 'Turbocharged', cc: 1199, torque: '170 Nm' },
    features: [ 'Touchscreen', 'Reverse Camera', 'Bluetooth Connectivity' ],
    sunroof: false,
    airbags: 2
  },
  {
    _id: ObjectId('690a31e6d72ea166af63b113'),
    maker: 'Hyundai',
    model: 'Creta',
    fuel_type: 'Diesel',
    transmission: 'Manual',
    engine: { type: 'Naturally Aspirated', cc: 1493, torque: '250 Nm' },
    features: [
      'Sunroof',
      'Leather Seats',
      'Wireless Charging',
      'Ventilated Seats',
      'Bluetooth'
    ],
    sunroof: true,
    airbags: 6
  },
]
```

```
test> db.cars.findOne()
{
  _id: ObjectId('690a31c2d72ea166af63b112'),
  maker: 'Tata',
  model: 'Nexon',
  fuel_type: 'Petrol',
  transmission: 'Automatic',
  engine: { type: 'Turbocharged', cc: 1199, torque: '170 Nm' },
  features: [ 'Touchscreen', 'Reverse Camera', 'Bluetooth Connectivity' ],
  sunroof: false,
  airbags: 2
}
test> db.cars.find({}, {model:1})
[
  { _id: ObjectId('690a31c2d72ea166af63b112'), model: 'Nexon' },
  { _id: ObjectId('690a31e6d72ea166af63b113'), model: 'Creta' },
  { _id: ObjectId('690a31e6d72ea166af63b114'), model: 'Baleno' },
  { _id: ObjectId('690a31e6d72ea166af63b115'), model: 'XUV500' },
  { _id: ObjectId('690a31e6d72ea166af63b116'), model: 'City' }
]
test> db.cars.find({}, {model:1, _id:0})
[
  { model: 'Nexon' },
  { model: 'Creta' },
  { model: 'Baleno' },
  { model: 'XUV500' },
  { model: 'City' }
]
test> db.cars.find({}, {model:1, maker:1, _id:0})
[
  { maker: 'Tata', model: 'Nexon' },
  { maker: 'Hyundai', model: 'Creta' },
  { maker: 'Maruti Suzuki', model: 'Baleno' },
  { maker: 'Mahindra', model: 'XUV500' },
  { maker: 'Honda', model: 'City' }
]
```

```
test> db.cars.find({"fuel_type":"Petrol"})
[
  {
    _id: ObjectId('690a31c2d72ea166af63b112'),
    maker: 'Tata',
    model: 'Nexon',
    fuel_type: 'Petrol',
    transmission: 'Automatic',
    engine: { type: 'Turbocharged', cc: 1199, torque: '170 Nm' },
    features: [ 'Touchscreen', 'Reverse Camera', 'Bluetooth Connectivity' ],
    sunroof: false,
    airbags: 2
  },
  {
    _id: ObjectId('690a31e6d72ea166af63b114'),
    maker: 'Maruti Suzuki',
    model: 'Baleno',
    fuel_type: 'Petrol',
    transmission: 'Automatic',
    engine: { type: 'Naturally Aspirated', cc: 1197, torque: '113 Nm' },
    features: [ 'Projector Headlamps', 'Apple CarPlay', 'ABS' ],
    sunroof: false,
    airbags: 2
  },
  {
    _id: ObjectId('690a31e6d72ea166af63b116'),
    maker: 'Honda',
    model: 'City',
    fuel_type: 'Petrol',
    transmission: 'Automatic',
    engine: { type: 'Naturally Aspirated', cc: 1498, torque: '145 Nm' },
    features: [ 'Keyless Entry', 'Auto AC', 'Multi-angle Rearview Camera' ],
    sunroof: false,
    airbags: 4
  }
]
```

```
test> db.cars.aggregate([
...   {
...     $group: {
...       _id: "$maker",
...       TotalCars: { $sum: 1 }
...     }
...   }
... ])
...
[
  { _id: 'Maruti Suzuki', TotalCars: 1 },
  { _id: 'Tata', TotalCars: 1 },
  { _id: 'Hyundai', TotalCars: 1 },
  { _id: 'Honda', TotalCars: 1 },
  { _id: 'Mahindra', TotalCars: 1 }
]
test> db.cars.aggregate([
...   {
...     $group: {
...       _id: "$fuel_type",
...       TotalCars: { $sum: 1 }
...     }
...   }
... ])
```

7. Learning Outcomes:

- Understand the concept of **NoSQL databases** and their differences from SQL databases.
- Gain knowledge of **MongoDB architecture**, including databases, collections, and documents.
- Learn to perform **CRUD operations** (Create, Read, Update, Delete) using MongoDB commands.
- Use operators such as `$set`, `$push`, `$pull`, `$unset`, and `$insert` for data manipulation.
- Apply **aggregation and grouping operations** using operators like `$sum`, `$avg`, `$min`, and `$max`.
- Develop the ability to query and analyze data efficiently in MongoDB.
- Compare the advantages and use cases of **SQL vs NoSQL** database models.
- Gain practical experience handling real-world data (e.g., car dealership dataset) using MongoDB.