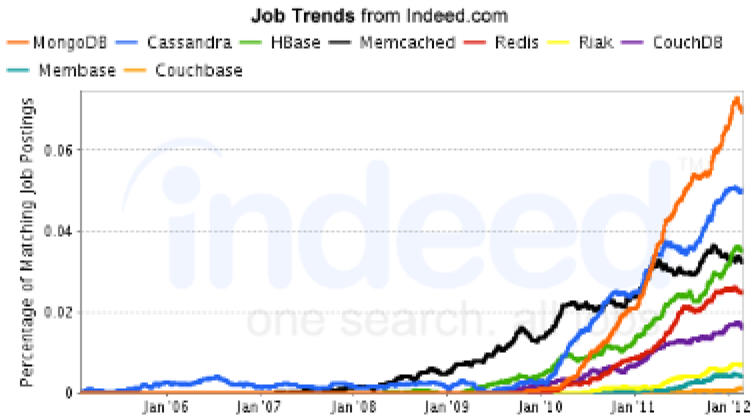
MongoDB

Introduction

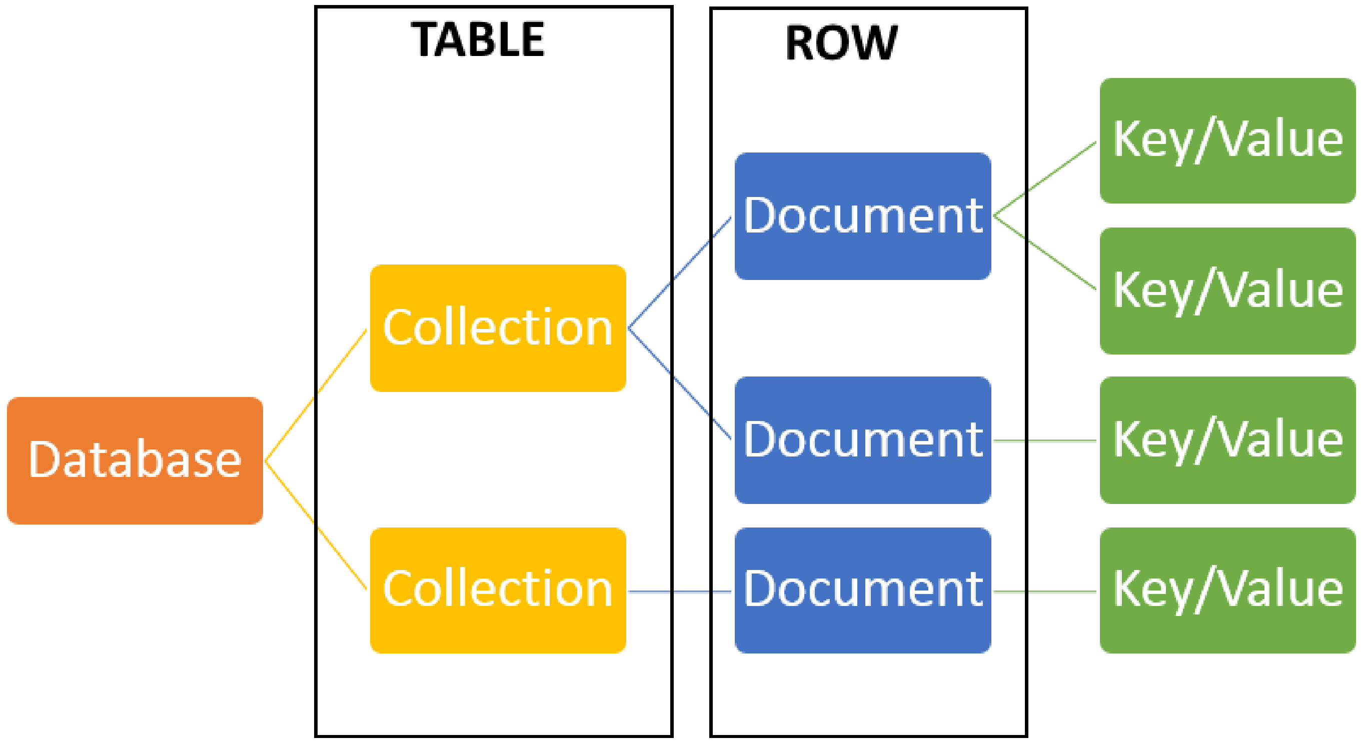
- MongoDB is an open-source database developed by MongoDB, Inc. (https://www.mongodb.com)
- MongoDB stores data in JSON-like (BSON) documents that can vary in structure.
- Related information is stored together for fast query access through the MongoDB query language.
- MongoDB uses dynamic schemas.

History

- 2007 - First developed (by 10gen)
- 2009 - Become Open Source
- 2010 - Considered production ready (v 1.4 >)
- *2013 - MongoDB Closes $150 Million in Funding*
- 2014 - Latest stable version (v 2.6)
- *Today- More than $231 million in total investment since 2007*
- *MongoDB inc. valuated $1.2B.*



MongoDB structure



Terminology and Concepts

SQL Terms/Concepts	MongoDB Terms/Concepts
database	database
table	collection
row	document or BSON document
column	field
index	index
table joins	$lookup, embedded documents
primary key Specify any unique column or column combination as primary key.	primary key In MongoDB, the primary key is automatically set to the _id field.
aggregation (e.g. group by)	aggregation pipeline

SQL to Aggregation Mapping Chart

SQL Terms, Functions, and Concepts	MongoDB Aggregation Operators
WHERE	$match
GROUP BY	$group
HAVING	$match
SELECT	$project
ORDER BY	$sort
LIMIT	$limit
SUM()	$sum
COUNT()	$sum
join	$lookup

MongoDB - Advantages

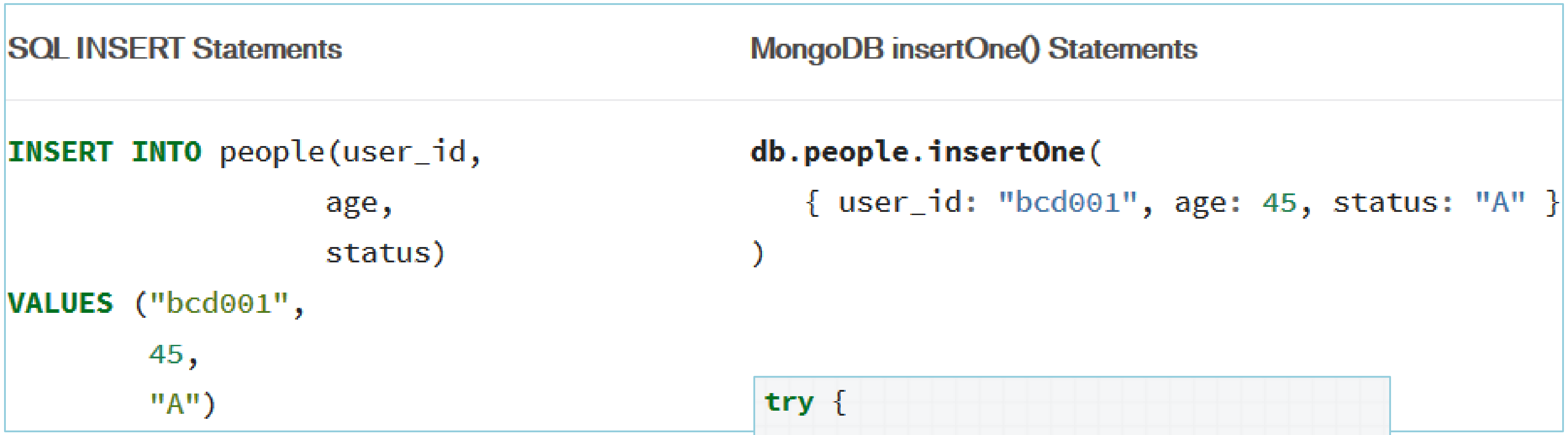
- Flexible Data Model
- Expressive Query Syntax
- Easy to Learn
- Performance
- Scalable and Reliable
- Reactive Streams Drivers
- Documentation
- Text Search
- Server-Side Script
- Documents = Objects

MongoDB – The bad

- Joins not Supported
- High Memory Usage
- Limited Data Size
- Limited Nesting
- No Triggers
- Duplicate Data

Insert document

- db.collection.insertOne()
- db.collection.insertMany()

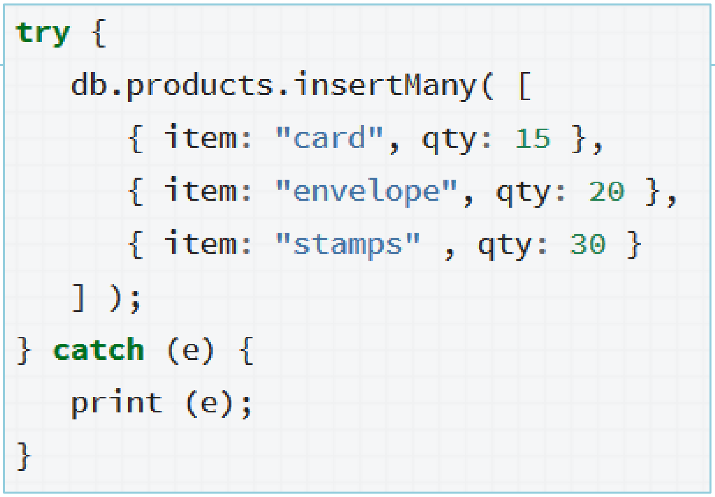


SQL INSERT Statements

```sql
INSERT INTO people(user_id,
                   age,
                   status)
VALUES ("bcd001",
        45,
        "A")
```

MongoDB insertOne() Statements

```javascript
db.people.insertOne(
   { user_id: "bcd001", age: 45, status: "A" }
)
```



```javascript
try {
   db.products.insertMany( [
      { item: "card", qty: 15 },
      { item: "envelope", qty: 20 },
      { item: "stamps" , qty: 30 }
   ] );
} catch (e) {
   print (e);
}
```

Find document(s)

db.collection.find(query, projection)

SQL SELECT Statements	MongoDB find() Statements
`SELECT *` `FROM people`	`db.people.find()`
`SELECT id,` `user_id,` `status` `FROM people`	`db.people.find(` `{ },` `{ user_id: 1, status: 1 }` `)`
`SELECT user_id, status` `FROM people`	`db.people.find(` `{ },` `{ user_id: 1, status: 1, _id: 0 }` `)`
`SELECT *` `FROM people` `WHERE status = "A"`	`db.people.find(` `{ status: "A" }` `)`

```
SELECT user_id, status    db.people.find(
FROM people                   { status: "A" },
WHERE status = "A"            { user_id: 1, status: 1, _id: 0 }
                          )
```

```
SELECT *                  db.people.find(
FROM people                   { status: { $ne: "A" } }
WHERE status != "A"       )
```

```
SELECT *                  db.people.find(
FROM people                   { status: "A",
WHERE status = "A"              age: 50 }
AND age = 50              )
```

```
SELECT *                  db.people.find(
FROM people                   { $or: [ { status: "A" } ,
WHERE status = "A"                     { age: 50 } ] }
OR age = 50               )
```

```
SELECT *                  db.people.find(
FROM people                   { age: { $gt: 25 } }
WHERE age > 25            )
```

```
SELECT *                  db.people.find(
FROM people                  { age: { $lt: 25 } }
WHERE age < 25            )
```

```
SELECT *                  db.people.find(
FROM people                  { age: { $gt: 25, $lte: 50 } }
WHERE age > 25            )
AND   age <= 50
```

```
SELECT *                  db.people.find( { user_id: /bc/ } )
FROM people
WHERE user_id like "%bc%" -or-

                          db.people.find( { user_id: { $regex: /bc/ } } )
```

```
SELECT *
FROM people
WHERE user_id like "bc%"
```

```
db.people.find( { user_id: /^bc/ } )
```

-or-

```
db.people.find( { user_id: { $regex: /^bc/ } } )
```

```
SELECT *
FROM people
WHERE status = "A"
ORDER BY user_id ASC
```

```
db.people.find( { status: "A" } ).sort( { user_id: 1 } )
```

```
SELECT *
FROM people
WHERE status = "A"
ORDER BY user_id DESC
```

```
db.people.find( { status: "A" } ).sort( { user_id: -1 } )
```

```
SELECT COUNT(*)
FROM people
```

```
db.people.count()
```

or

```
db.people.find().count()
```

`SELECT COUNT(user_id)`
`FROM people`
	`db.people.count( { user_id: { $exists: true } } )`
	
	or
	
	`db.people.find( { user_id: { $exists: true } } ).count()`

`SELECT COUNT(*)`
`FROM people`
`WHERE age > 30`
	`db.people.count( { age: { $gt: 30 } } )`
	
	or
	
	`db.people.find( { age: { $gt: 30 } } ).count()`

`SELECT DISTINCT(status)`
`FROM people`
	`db.people.distinct( "status" )`

`SELECT *`
`FROM people`
`LIMIT 1`
	`db.people.findOne()`
	
	or
	
	`db.people.find().limit(1)`

`SELECT *`
`FROM people`
`LIMIT 5`
`SKIP 10`
	`db.people.find().limit(5).skip(10)`

Explain query

```
EXPLAIN SELECT *
FROM people
WHERE status = "A"
```

```
db.people.find( { status: "A" } ).explain()
```

Others criteria

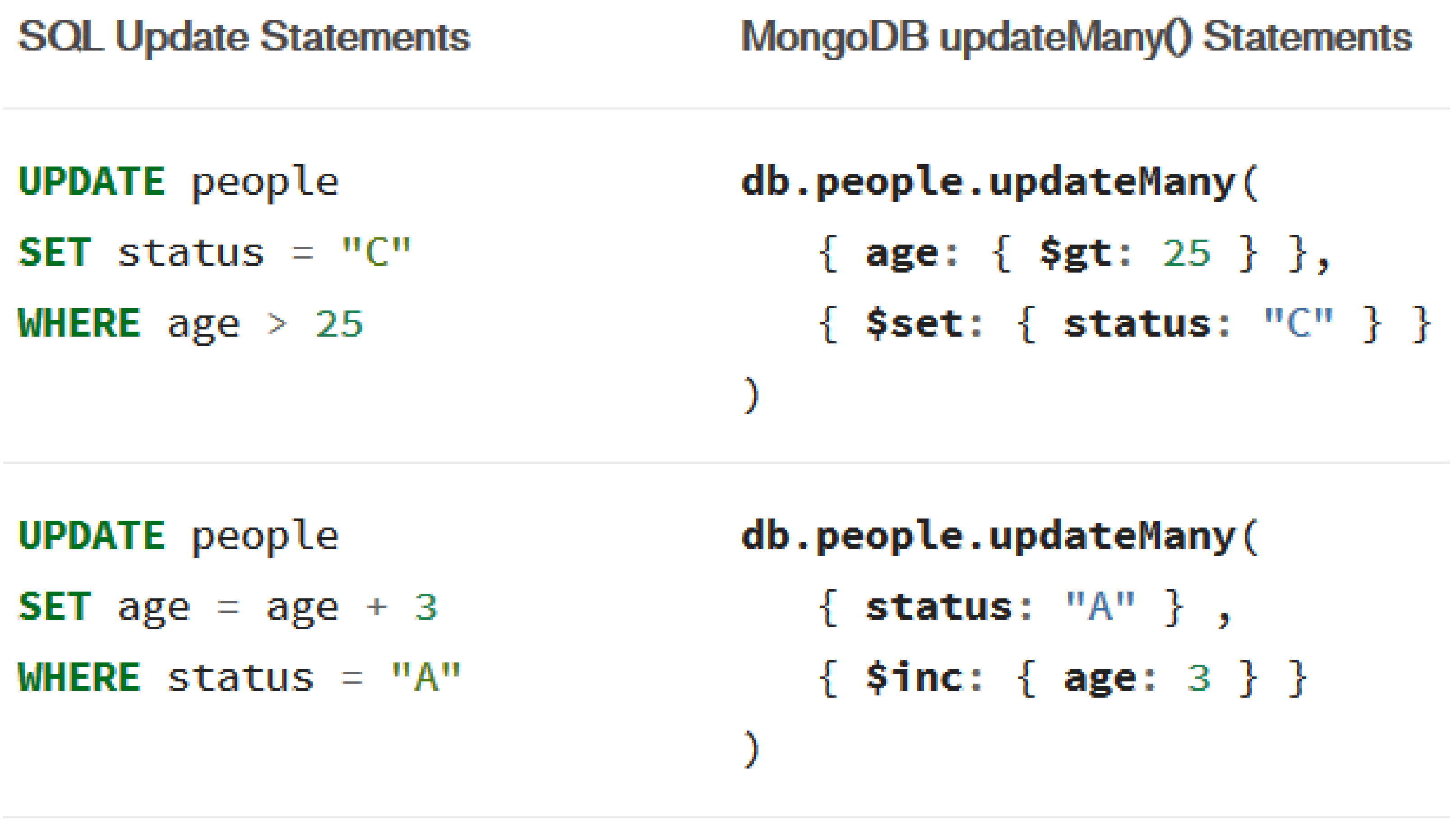
- limit()
- skip()
- explain()
- sort()
- count()
- pretty()
- …

Update document

db.collection.updateOne(<filter>, <update>, <options>)

db.collection.updateMany(<filter>, <update>, <options>)

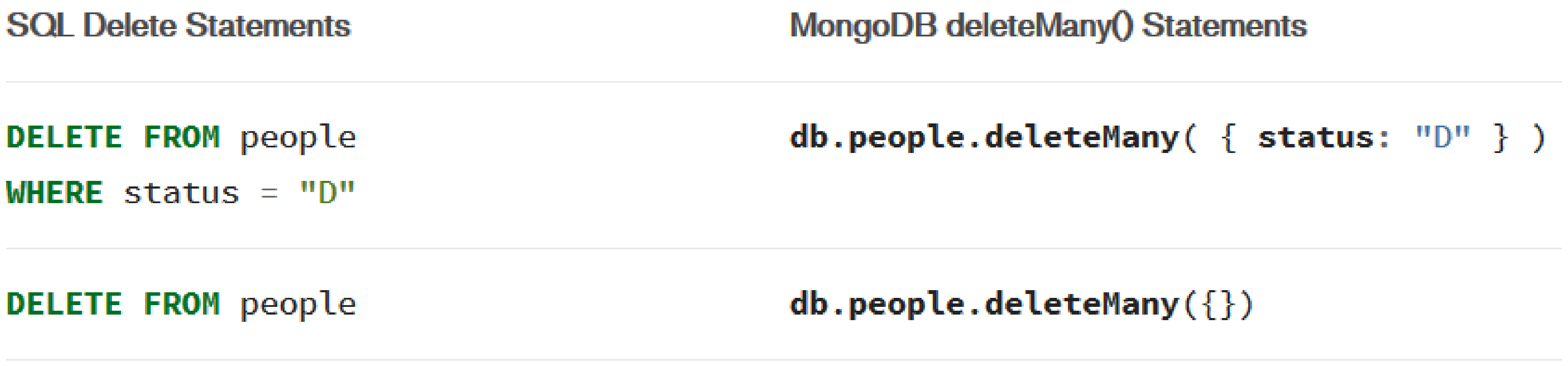
db.collection.replaceOne(<filter>, <replacement>, <options>)



SQL Update Statements	MongoDB updateMany() Statements
`UPDATE people SET status = "C" WHERE age > 25`	`db.people.updateMany( { age: { $gt: 25 } }, { $set: { status: "C" } } )`
`UPDATE people SET age = age + 3 WHERE status = "A"`	`db.people.updateMany( { status: "A" } , { $inc: { age: 3 } } )`

Delete document

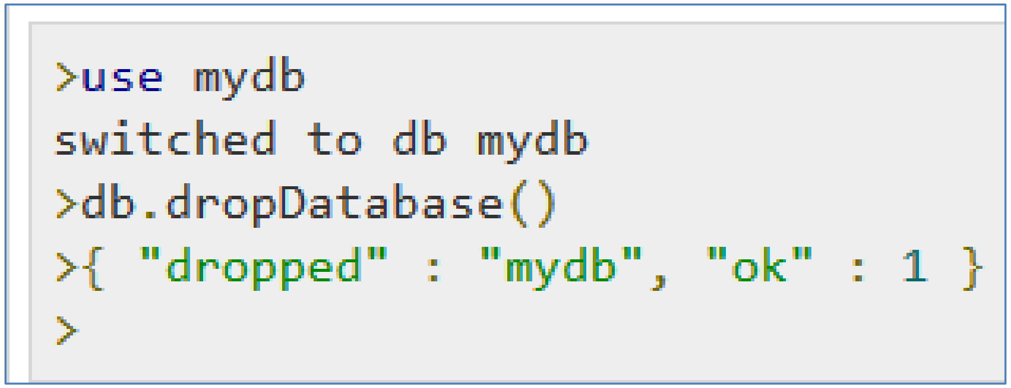
- db.collection.deleteMany()
- db.collection.deleteOne()



SQL Delete Statements	MongoDB deleteMany() Statements
`DELETE FROM people WHERE status = "D"`	`db.people.deleteMany( { status: "D" } )`
`DELETE FROM people`	`db.people.deleteMany({})`

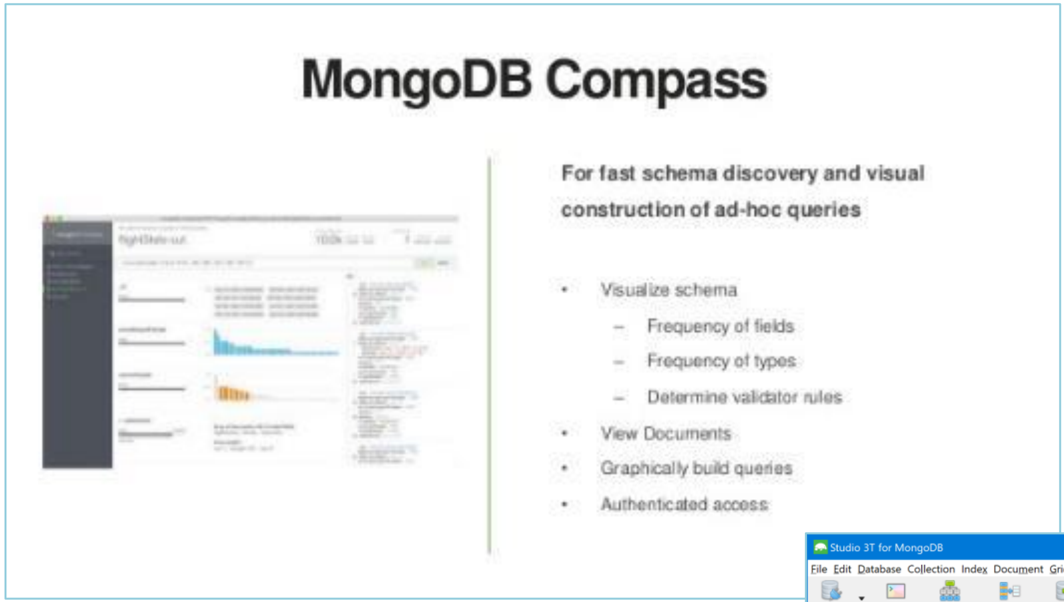
Drop databse

- MongoDB db.dropDatabase() command is used to drop a existing database.
- This will delete the selected database. If you have not selected any database, then it will delete default 'test' database.



```
>use mydb
switched to db mydb
>db.dropDatabase()
>{ "dropped" : "mydb", "ok" : 1 }
>
```

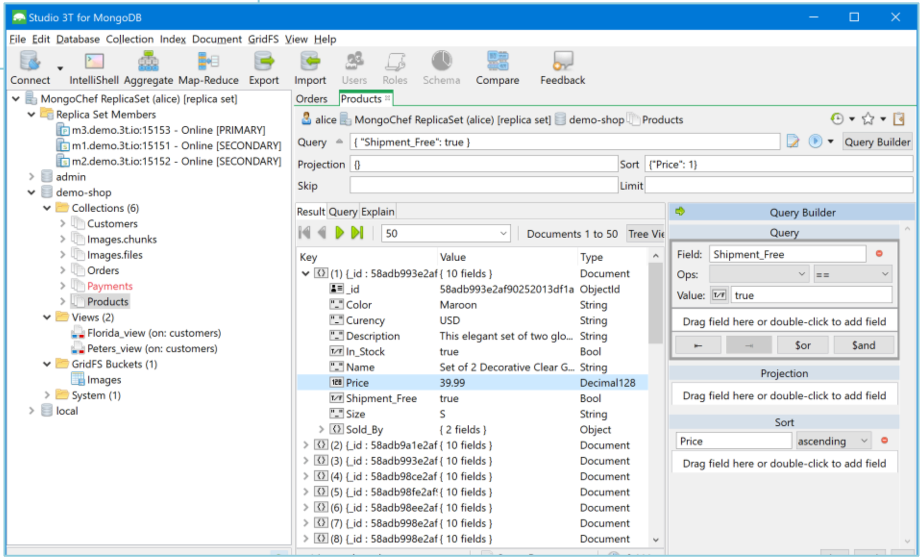
Using Management tools



MongoDB Compass

For fast schema discovery and visual construction of ad-hoc queries

- Visualize schema
  - Frequency of fields
  - Frequency of types
  - Determine validator rules
- View Documents
- Graphically build queries
- Authenticated access


Studio 3T for MongoDB
File Edit Database Collection Index Document GridFS View Help
Connect IntelliShell Aggregate Map-Reduce Export Import Users Roles Schema Compare Feedback
Orders Products

MongoChef ReplicaSet (alice) [replica set]
- Replica Set Members
  - m3.demo.3t.io:15153 - Online [PRIMARY]
  - m1.demo.3t.io:15151 - Online [SECONDARY]
  - m2.demo.3t.io:15152 - Online [SECONDARY]
- admin
- demo-shop
  - Collections (6)
    - Customers
    - Images.chunks
    - Images.files
    - Orders
    - Payments
    - Products
  - Views (2)
    - Florida_view (on: customers)
    - Peters_view (on: customers)
  - GridFS Buckets (1)
    - Images
  - System (1)
- local

alice MongoChef ReplicaSet (alice) [replica set] demo-shop Products

Query: { "Shipment_Free": true }
Projection: {}
Sort: {"Price": 1}
Skip:
Limit:

Result Query Explain — 50 — Documents 1 to 50 — Tree View

Key	Value	Type
(1) {_id : 58adb993e2af	{ 10 fields }	Document
_id	58adb993e2af90252013df1a	ObjectId
Color	Maroon	String
Curency	USD	String
Description	This elegant set of two glo...	String
In_Stock	true	Bool
Name	Set of 2 Decorative Clear G...	String
Price	39.99	Decimal128
Shipment_Free	true	Bool
Size	S	String
Sold_By	{ 2 fields }	Object
(2) {_id : 58adb9a1e2af	{ 10 fields }	Document
(3) {_id : 58adb993e2af	{ 10 fields }	Document
(4) {_id : 58adb98ce2af	{ 10 fields }	Document
(5) {_id : 58adb98fe2af	{ 10 fields }	Document
(6) {_id : 58adb98ee2af	{ 10 fields }	Document
(7) {_id : 58adb998e2af	{ 10 fields }	Document
(8) {_id : 58adb998e2af	{ 10 fields }	Document

Query Builder
Query
Field: Shipment_Free
Ops: ==
Value: true
Drag field here or double-click to add field
$or $and
Projection
Drag field here or double-click to add field
Sort
Price ascending
Drag field here or double-click to add field

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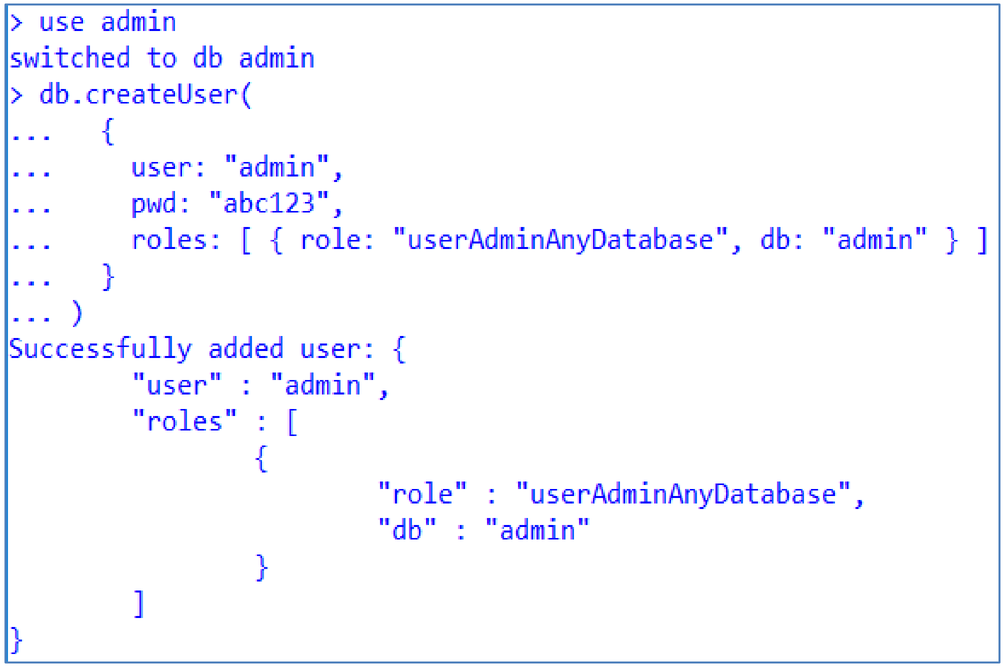
Authentication enable

- Grant permission to users to authenticate
  - Central database
  - Each database
- Policies:
  - readAnyDatabase
  - readWriteAnyDatabase
  - userAdminAnyDatabase
  - dbAdminAnyDatabase

Authentication enable

1. Create admin database
2. Add admin user



```
> use admin
switched to db admin
> db.createUser(
...   {
...     user: "admin",
...     pwd: "abc123",
...     roles: [ { role: "userAdminAnyDatabase", db: "admin" } ]
...   }
... )
Successfully added user: {
        "user" : "admin",
        "roles" : [
                {
                        "role" : "userAdminAnyDatabase",
                        "db" : "admin"
                }
        ]
}
```

3. Client logon:

   mongo -u "admin" -p "abc123" -authenticationDatabase "admin"

MongoDB Java Drivers

- Driver:
  https://www.mongodb.com/docs/drivers/java-drivers/
- Sync
  https://www.mongodb.com/docs/drivers/java/sync/current/
- MongoDB Java Reactive Streams
  https://www.mongodb.com/docs/drivers/reactive-streams/

Connect MongoDB - Sync driver

- Without authentication

```
com.mongodb.MongoClient cl=new MongoClient("localhost",27017);
```

- Authentication enable

```
List<ServerAddress>servers=new ArrayList<>();
servers.add(new ServerAddress("localhost",27017));

List<MongoCredential> credentialsList=new ArrayList<>();
MongoCredential credential=MongoCredential.createCredential(
        "admin", //userName
        "admin", //authentication database
        "abc123".toCharArray()//password
        );
credentialsList.add(credential);

com.mongodb.MongoClient mongoClient=new MongoClient(
        servers,
        credentialsList);
```

Get all databases

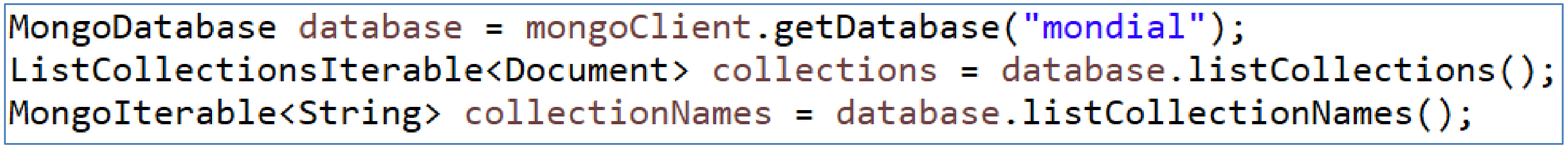
```
MongoIterable<String> ldb = mongoClient.listDatabaseNames();
//ldb.iterator().forEachRemaining(t->{System.out.println(t);});

ldb.forEach(new Block<String>() {
    @Override
    public void apply(String s) {
        System.out.println(s);
    }
});
```

- Get specific database

```
MongoDatabase database = mongoClient.getDatabase("mondial");
```

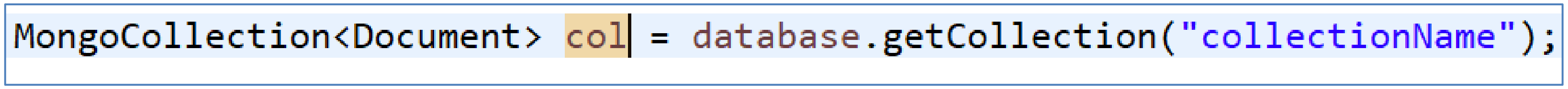
Get collections

- Get all collections



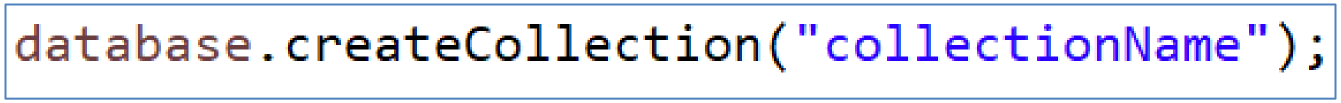
```
MongoDatabase database = mongoClient.getDatabase("mondial");
ListCollectionsIterable<Document> collections = database.listCollections();
MongoIterable<String> collectionNames = database.listCollectionNames();
```

- Get specific collection



```
MongoCollection<Document> col = database.getCollection("collectionName");
```

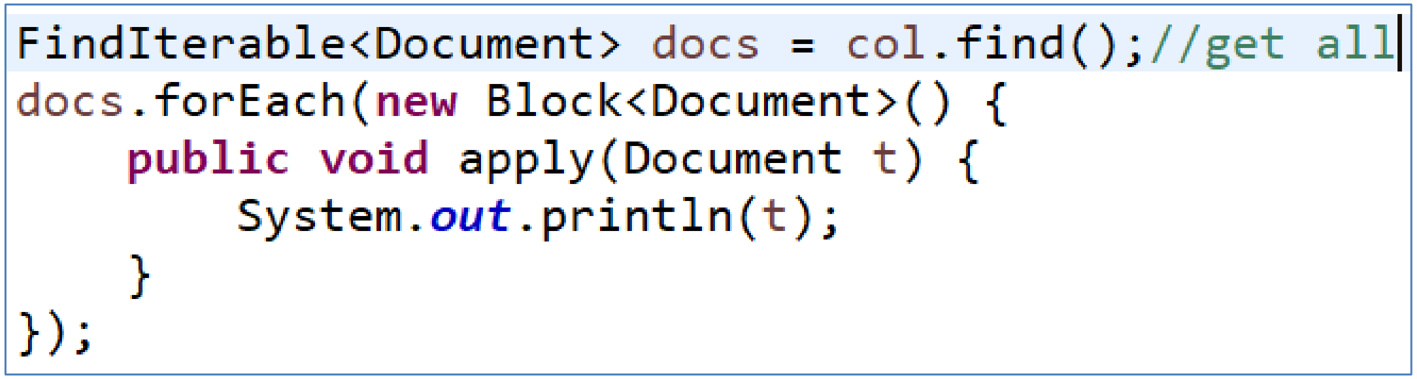
- Create a collection



```
database.createCollection("collectionName");
```

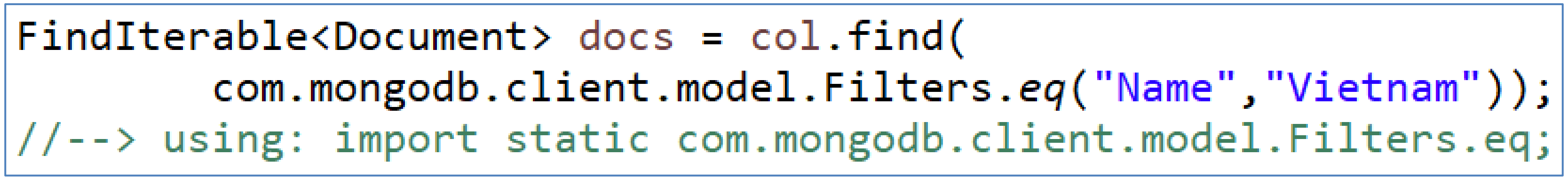
Query

- Get all records



```java
FindIterable<Document> docs = col.find();//get all
docs.forEach(new Block<Document>() {
    public void apply(Document t) {
        System.out.println(t);
    }
});
```

- Filter criteria



```java
FindIterable<Document> docs = col.find(
        com.mongodb.client.model.Filters.eq("Name","Vietnam"));
//--> using: import static com.mongodb.client.model.Filters.eq;
```

Insert

- Insert a Document object

```
void insert(MongoCollection<Document> col) {
    Document lop=new Document("malop", "DHTH10A")
            .append("tenlop", "Lớp DH KỸ Thuật PHẦN MỀM 10A");
    col.insertOne(lop);
}
```

- Insert a BasicDBObject object

```
void insert2( MongoDatabase database) {
    MongoCollection<BasicDBObject> collection
        = database.getCollection("lophoc", BasicDBObject.class);
    Map<String,String> map =new HashMap<>();
    map.put("malop", "CDTH9LT");
    map.put("tenlop", "Lớp cao đẳng 9 liên thông");
    BasicDBObject bo1=new BasicDBObject(map);
    collection.insertOne(bo1);
}
```

Update

```
void update(MongoCollection<Document> col) {
    //1. new data could update
    BasicDBObject newDocument=new BasicDBObject();
    newDocument.append("$set",
            new BasicDBObject().append("tenlop",
                    "Lớp DHKIẾN TRÚC PHẦN MỀM 11B CLC"));
    //2. filter object to update
    BasicDBObject filter=new BasicDBObject().append("malop", "DHTH10A");

    //3. update
    col.updateOne(filter, newDocument);
}
```

```
void update2(MongoCollection<Document> col) {
    BasicDBObject filter=new BasicDBObject()
            .append("malop", "DHTH10A");
    BasicDBObject update=new BasicDBObject()
            .append("$set",
                    new BasicDBObject()
                    .append("tenlop", "new value"));
    col.findOneAndUpdate(filter, update);
}
```

Delete

```
void delete(MongoCollection<Document> col) {
    BasicDBObject filter=new BasicDBObject()
            .append("malop", "1a");
    Document doc=col.findOneAndDelete(filter);
    //if(doc!=null) ==>success
}
```

Using POJO

- By default, a MongoCollection is configured with Codecs for three classes:
  - Document
  - BasicDBObject
  - BsonDocument
- Applications, however, are free to register Codec implementations for other classes by customizing the CodecRegistry.
  - In a MongoClient via MongoClientSettings
  - In a MongoDatabase via its withCodecRegistry method
  - In a MongoCollection via its withCodecRegistry method

Using POJO

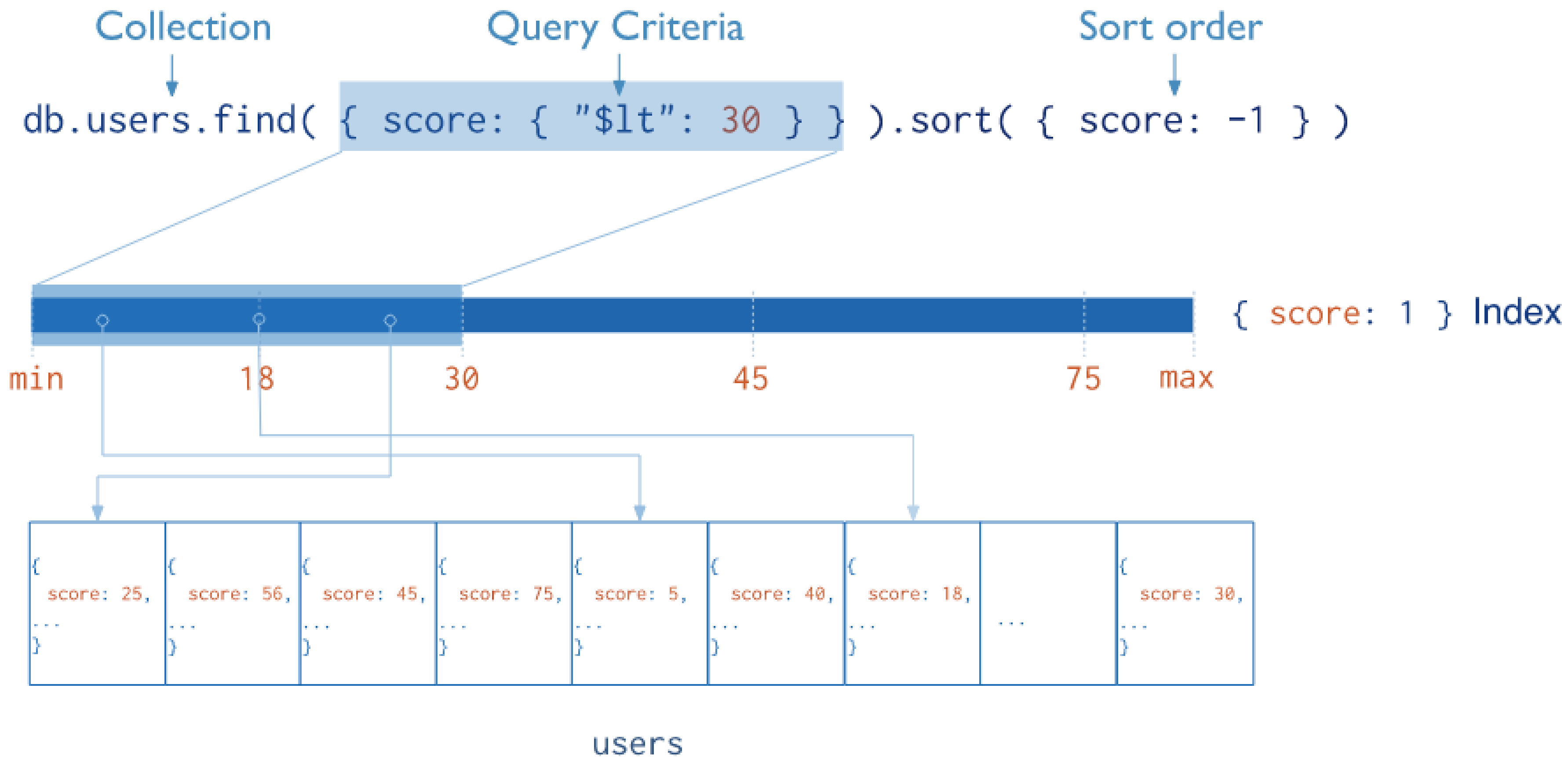
- Using the PojoCodecProvider.builder() to create and configure a CodecProvider
- Example:

```
CodecRegistry registry = CodecRegistries.
fromRegistries(MongoClientSettings.getDefaultCodecRegistry(),CodecR
egistries.fromProviders(PojoCodecProvider.builder().automatic(true).bui
ld()));
MongoCollection<Zip> zipCol = db.getCollection("zips",
Zip.class).withCodecRegistry(registry);
```

MongoDB - Indexes

- Indexes support the efficient execution of queries in MongoDB. Without indexes, MongoDB must perform a collection scan, i.e. scan every document in a collection, to select those documents that match the query statement.
- If an appropriate index exists for a query, MongoDB can use the index to limit the number of documents it must inspect.
- MongoDB defines indexes at the collection level and supports indexes on any field or sub-field of the documents in a MongoDB collection.

MongoDB - Indexes



MongoDB - Indexes

Default _id Index

- MongoDB creates a unique index on the _id field during the creation of a collection.

Create an Index

- Creates indexes on collections:

  db.collection.createIndex(<keys>, <options>)

  Options:

  - An ascending index: 1
  - A descending index: -1

MongoDB - Indexes

Index Types (1)

- **Single Field:** MongoDB supports the creation of user-defined ascending/descending indexes on a single field of a document.
- **Compound Indexes:** MongoDB supports compound indexes, where a single index structure holds references to multiple fields within a collection's documents.
- **Multikey Indexes:** To index a field that holds an array value, MongoDB creates an index key for each element in the array.

MongoDB - Indexes

Index Types (2)

- **Text Indexes:** MongoDB provides text indexes to support text search queries on string content.

  To create index on a field that contains a string or an array of string elements, include the field and specify the string literal “text” in the index document.

  Ex: db.people.createIndex({firstname: "text" })

- **Wildcard Indexes:** MongoDB 4.2 introduces wildcard indexes for supporting queries against unknown or arbitrary fields.
  - Create a wildcard index on a field:

    ```
    db.collection.createIndex( { "fieldA.$**" : 1 } )
    ```
  - Create a Wildcard Index on All Fields:

    ```
    db.collection.createIndex( { "$**" : 1 } )
    ```

MongoDB - Indexes

Index Properties

- **Unique Indexes:** A unique index ensures that the indexed fields do not store duplicate values.

  Create a Unique Index:

  ```
  db.collection.createIndex( <keys>, { unique: true } )
  ```

- **Partial Indexes:** Partial indexes only index the documents in a collection that meet a specified filter expression.

  To create a partial index, use **db.collection.createIndex()** method with the partialFilterExpression option.

  Ex:
  ```
  db.restaurants.createIndex(
     { cuisine: 1, name: 1 },
     { partialFilterExpression: { rating: { $gt: 5 } } }
  )
  ```

MongoDB - Indexes

Index Properties

For example, the following operation creates a compound index that indexes only the documents with a rating field greater than 5.

```
db.restaurants.createIndex(
   { cuisine: 1, name: 1 },
   { partialFilterExpression: { rating: { $gt: 5 } } }
)
```

MongoDB - Indexes

Manage Indexes

- View Existing Indexes: db.collection.getIndexes()
- Remove Indexes:
  - Remove Specific Index: db.collection.dropIndex()
  - Remove All Indexes: db.collection.dropIndexes()