Advanced MongoDB Rich Documents

CS571 – Mobile Application Development

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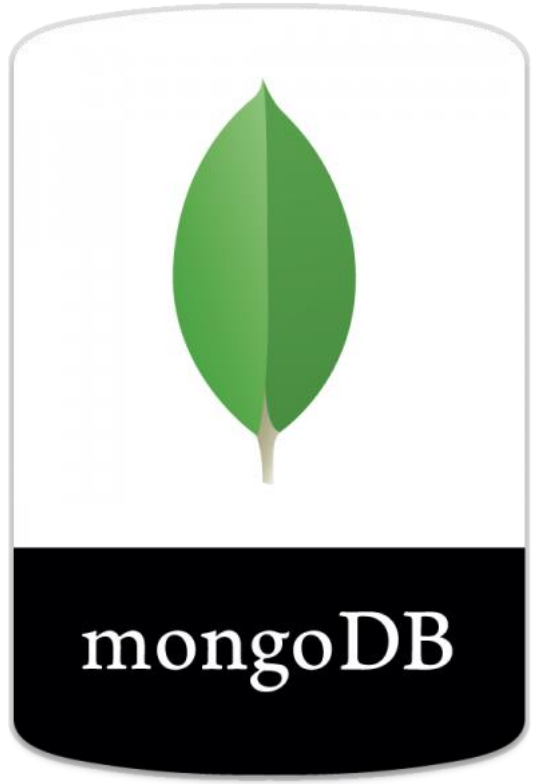
MongoDB

- Open-source document database
- High performance, high availability, and automatic scaling.
- Non relational DB, stores BSON documents.
- Schema-less: Two documents don't have the same schema.

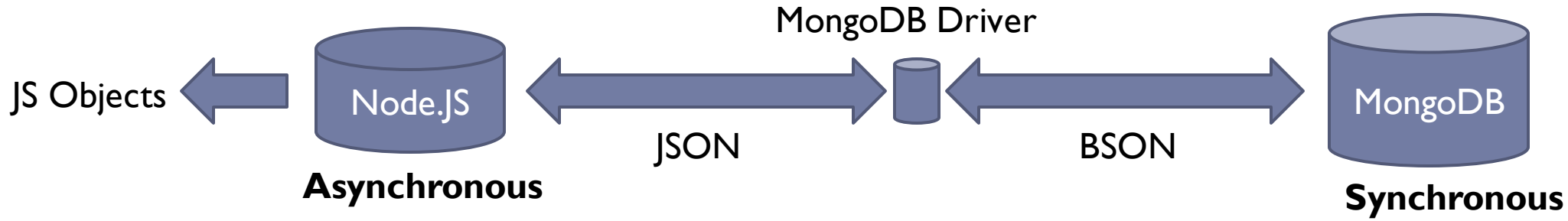


MongoDB Driver

- A library written in JS to handle the communication, open sockets, handle errors and talk with MongoDB Server.

```
npm install mongodb
```

- Note that Mongo Shell is **Synchronous** while Node.JS is **Asynchronous**.



CRUD in MongoDB

There is no special SQL language to perform CRUD in MongoDB.

Many CRUD operations exist as methods/functions on objects in programming language API, NOT as separate language.

CRUD	MongoDB
Read	`find()`
Create	`insert()`
Update	`update()`
Delete	`remove()`

Mongo Atlas

- Create DB at https://www.mongodb.com/
- Init a NodeJS program
- Connect NodeJS program to Mongo Atlas using MongoDB
- Implement a function to insert a document to DB
- Collection: Users, {_id: 1, name: 'Mike'}

Connect to MongoDB using mongodb

```
const {MongoClient} = require('mongodb');

Let db = null;

async function main(){
let uri  = "mongodb+srv://<user>:<password>@cluster0.l9zyoim.mongodb.net"
const client = new MongoClient(uri);
await client.connect();
db = client.db('test');//connect to the database 'test'
}


main().then(() => db.collection('users').insertOne({name: 'Thao'}))
.catch(error => console.log(error));
```

Searching an Array

```
// { _id: 1, courses: [ "CS471", "CS571", "CS435" ] }
// find all documents where courses value contains "CS571"
db.col.find({ courses: "CS571" })

// find all documents where courses value contains "CS471" or "CS571"
db.col.find({ courses: { $in: ["CS571", "CS471"] } })

// find all documents where courses value contains "CS471" and "CS571"
db.col.find({ courses: { $all: [ "CS571" , "CS471" ] } })
```

The **`$in`** operator selects the documents where the value of a field is an array that contains at any order any (at least one) of the specified elements

The **`$all`** operator selects the documents where the value of a field is an array that contains at any order all the specified elements

Search with $elemMatch

```
{ _id: 1, results: [ 1, 2, 5, 10 ] }
{ _id: 2, results: [ 5, 8, 9, 10 ] }
{ _id: 3, results: [ 10, 11, 12 ] }

db.test.find( { results: { $in: [ 5, 10 ] } } )
// scan results for value n times (accepts only value, no operators)
// one value must exist to return the document

db.test.find( { results: { $elemMatch: { $gt: 5, $lt: 10 } } } )
// scan results array once: check if there is one value matches the condition
// _id: 2
```

$elemMatch

The **$elemMatch** operator matches documents that contain an array field with at least one **element** that matches **ALL** the specified query criteria.

```
{ _id: 1, results: [ { product: "abc", score: 10 }, { product: "xyz", score: 5 } ] }
{ _id: 2, results: [ { product: "abc", score: 8 }, { product: "xyz", score: 7 } ] }
{ _id: 3, results: [ { product: "abc", score: 7 }, { product: "xyz", score: 8 } ] }

db.survey.find( { results: { $elemMatch: { product: "xyz", score: { $gte: 8 } } } } ) // _id: 3
```

Searching an Object

```
{_id: 1, email: { work: "work@miu.edu", personal: "personal@gmail.com"} }

// nothing will be returned
db.col.find({ email: { work: "work@miu.edu" } })
db.col.find({ email: { personal: "personal@gmail.com" } })
db.col.find({ email: { personal: "personal@gmail.com", work: "work@miu.edu"} })

// will work
db.col.find({ email: { work: "work@miu.edu", personal: "personal@gmail.com"} })

// how to search for one key only?
db.col.find({ "email.work": "work@miu.edu" })
db.col.find({ "email.personal": "personal@gmail.com" })
```

Update Methods

`db.collection.updateOne()`

Updates at most a single document that match a specified filter even though multiple documents may match the specified filter.

`db.collection.updateMany()`

Update all documents that match a specified filter.

Field Update Operators

By default, **`updateOne()`** will: update a **single document** and **replace** everything but the **`_id`**

```
// To target only one field use { $set: { field1: value1, ... } }
// If the field does not exist, $set will add a new field with the
   specified value
{ "_id" : "1", "students": 250, "courses" : ["CS571", "CS472"] }
db.col.updateOne({_id:"1"}, {$set: {"students": 500, "entry": "Aug"} })
// Results
{ "_id" : "1", "students": 500, "courses" : ["CS571", "CS472"] , "entry":"Aug" }
```

Field Update Operators

```
// update all docs to have one more field (city: Fairfield)
{ "_id" : "1", "program" : "CompPro" }
{ "_id" : "2", "program" : "MSD" }
db.col.updateMany({}, {$set: {"city":"Fairfield"}})
// Results
{ "_id" : "1", "program" : "CompPro", "city":"Fairfield" }
{ "_id" : "2", "program" : "MSD", "city":"Fairfield" }
```

Field Update Operators

Update Operator	Description	Notes
`$set`	Replaces the value of a field with the specified value	If the field does not exist, `$set` will add a new field with the specified value
`$unset`	Deletes a particular field, The specified value in the $unset expression does not impact the operation.	If the field does not exist, then `$unset` does nothing
`$inc`	Increments a field by a specified value, it accepts positive and negative values	If the field does not exist, `$inc` creates the field and sets the field to the specified value

Examples - Field Update Operators

```
{ "_id" : "1", "students" : 250 }
db.col.updateOne({_id:"1"}, { $inc : { "students":1, "exams":1 } })
{ "_id" : "1", "students" : 251, "exams":1 }
```

```
{ "_id" : "1", "students" : 250, "program": "MSD" }
db.col.updateOne({_id:"1"}, { $unset : { "program":1 } })
{ "_id" : "1", "students" : 250 }
```

Array Update Operators

```
//Original Document { "_id" : 1, "a" : [1, 2, 3, 4] }
db.testCol.updateOne({_id:1}, { $set : { "a.2":5 } }) // Update item in Array by
INDEX
// output: { "_id" : 1, "a" : [1, 2, 5, 4] }
db.col.updateOne({_id:1}, { $push : { "a": 6 } }) // Add item to Array
// output: { "_id" : 1, "a" : [1, 2, 5, 4, 6] }
db.col.updateOne({_id:1}, { $pop : { "a": 1 } })
// output: { "_id" : 1, "a" : [1, 2, 5, 4] }
db.col.updateOne({_id:1}, { $pop : { "a": -1 } })
// output: { "_id" : 1, "a" : [2, 5, 4] }
db.col.updateOne({_id:1}, { $pull : { "a": 5 } }) // Remove items from Array
// output: { "_id" : 1, "a" : [2, 4] }
db.col.updateOne({_id:1}, { $addToSet : { "a": 5 } })
// output: { "_id" : 1, "a" : [2, 4, 5] }
db.col.updateOne({_id:1}, { $addToSet : { "a": 5 } })
// output: { "_id" : 1, "a" : [2, 4, 5] }
```

$ (The Array POSITION that matched)

The positional **$** operator identifies an **element** in an array to **update** without explicitly specifying the position of the element in the array.

```
{ "_id" : 1, "grades" : [ 85, 80, 84, 80 ] }
db.students.updateOne( { _id: 1, grades: 80 }, { $set: { "grades.$" : 82 } } )
// { "_id" : 1, "grades" : [ 85, 82, 84, 80 ] }

{ _id: 4, grades: [ { total: 80, mean: 75, student: 8 },
                    { total: 85, mean: 90, student: 5 },
                    { total: 86, mean: 85, student: 8 } ] }
db.students.updateOne( { _id: 4, "grades.total": 85 },
                       { $set: { "grades.$.student" : 6 } } )
// { "total" : 85, "mean" : 90, "student" : 6 }
```

You must include the array field as part of the query.

$elemMatch vs. arrayFilters

```
{ _id: 5, grades: [ { total: 80, mean: 75, student: 8 },
                    { total: 85, mean: 90, student: 5 },
                    { total: 90, mean: 85, student: 3 } ] }

db.students.updateOne(
  { _id: 5, grades: { $elemMatch: { total: { $lte: 90 }, mean: { $gt: 80 } } } },
  { $set: { "grades.$.student" : 6 } }
)
```

```
{ total: 85, mean: 90, student: 6}
Only updates one element that matches our condition
```

```
db.students.updateOne(
  { _id: 5 },
  { $set: { "grades.$[obj].student" : 6 } } ,
  { arrayFilters: [{ "obj.total": { $lte: 90 } ,"obj.mean": { $gt: 80 } }] }
)
```

```
{ total: 85, mean: 90, student: 6 }, { total: 90, mean: 85, student: 6 }
Always updates all elements in the array that match our condition
```

Using arrayFilters

```
{ "_id" : 1,
  "grades" : [
        { type: "quiz", questions: [ 10, 8, 5 ] },
        { type: "quiz", questions: [ 8, 9, 6 ] },
        { type: "hw", questions: [ 5, 4, 3 ] },
        { type: "exam", questions: [ 25, 10, 23, 0 ] },
] }

db.students.updateMany(
  {},
  { $inc: { "grades.$[t].questions.$[score]": 2 } },
  { arrayFilters: [ { "t.type": "quiz" } , { "score": { $gte: 8 } } ]
)


{ "type" : "quiz", "questions" : [ 12, 10, 5 ] },
{ "type" : "quiz", "questions" : [ 10, 11, 6 ] },
```

$elemMatch vs. arrayFilters

```
{grades:[10,20,20]}
{grades:[10,20,20]}

db.test.updateMany({grades: { $elemMatch: { $gt: 10 , $lt: 30 } }},
                   {$set:{'grades.$': 15}})


{ "grades" : [ 10, 15, 20 ] }
{ "grades" : [ 10, 15, 20 ] }
db.test.updateMany({},
                   {$set:{'grades.$[c]': 30}},
                   { arrayFilters: [ { "c": {$gt: 10 , $lt: 30} } ])



{ "grades" : [ 10, 30, 30 ] }
{ "grades" : [ 10, 30, 30 ] }
```