

Introduction to Mongoose for MongoDB



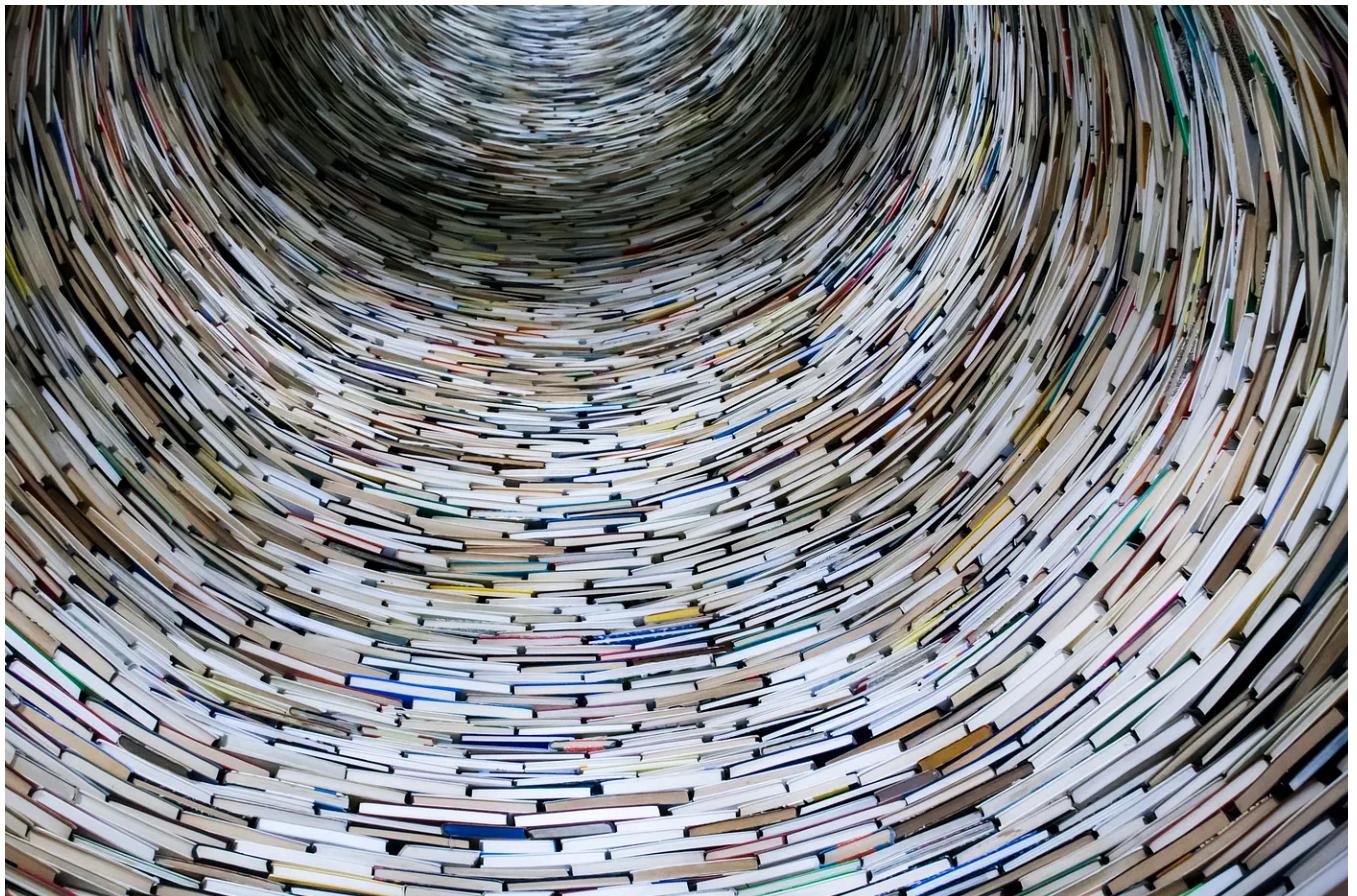
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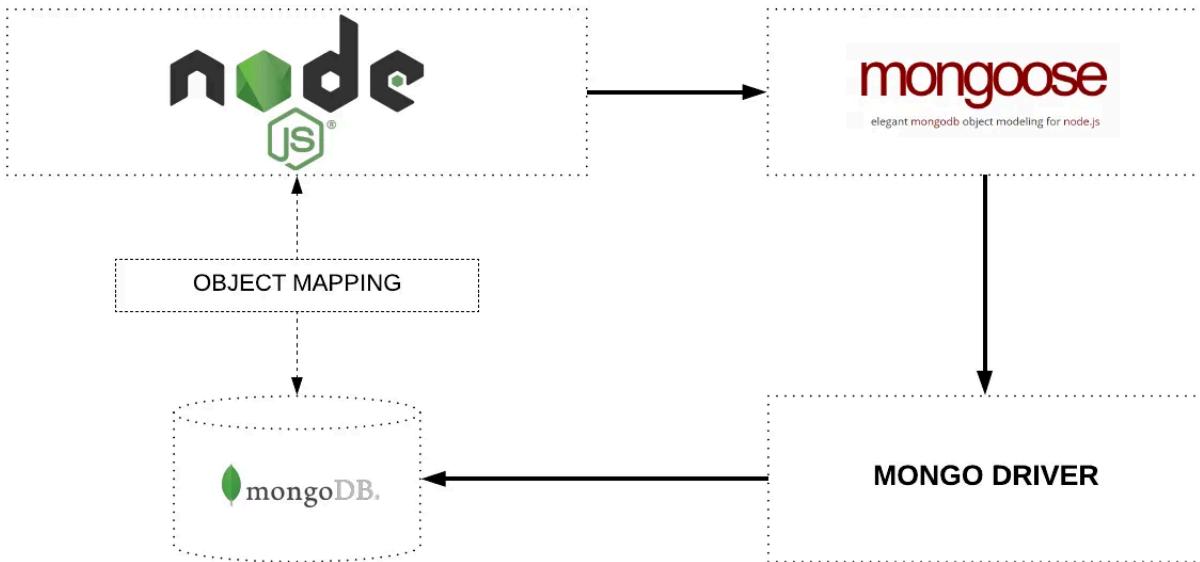
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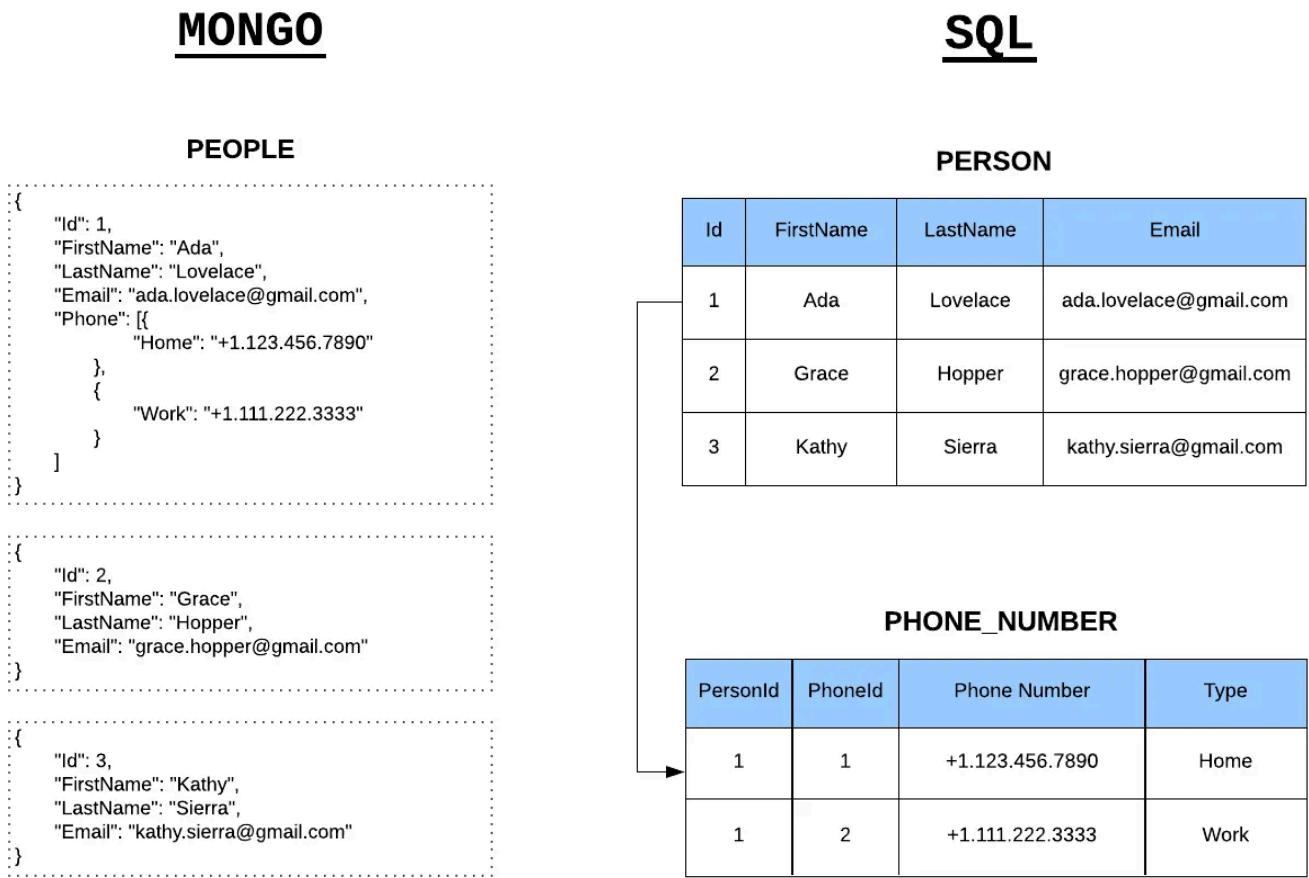
Mongoose is an Object Data Modeling (ODM) library for MongoDB and Node.js. It manages relationships between data, provides schema validation, and is used to translate between objects in code and the representation of those objects in MongoDB.



Object Mapping between Node and MongoDB managed via Mongoose

MongoDB is a schema-less NoSQL document database. It means you can store JSON documents in it, and the structure of these documents can vary as it is not enforced like SQL databases. This is one of the advantages of using NoSQL as it speeds up application development and reduces the complexity of deployments.

Below is an example of how data is stored in Mongo vs. SQL Database:



NoSQL Documents vs. Relational Tables in SQL

Terminologies

Collections

'Collections' in Mongo are equivalent to tables in relational databases. They can hold multiple JSON documents.

Documents

'Documents' are equivalent to records or rows of data in SQL. While a SQL row can reference data in other tables, Mongo documents usually combine that in a document.

Fields

'Fields' or attributes are similar to columns in a SQL table.

Schema

While Mongo is schema-less, SQL defines a schema via the table definition. A Mongoose 'schema' is a document data structure (or shape of the document) that is

enforced via the application layer.

Models

'Models' are higher-order constructors that take a schema and create an instance of a document equivalent to records in a relational database.

Getting Started

Mongo Installation

Before we get started, let's setup Mongo. You can choose from **one of the following options** (we are using option #1 for this article):

1. Download the appropriate MongoDB version for your Operating System from the [MongoDB Website](#) and follow their installation instructions
2. [Create a free sandbox database](#) subscription on mLab
3. [Install Mongo using Docker](#) if you prefer to use docker

Let's navigate through some of the basics of Mongoose by implementing a model that represents data for a simplified address book.

I am using Visual Studio Code, Node 8.9, and NPM 5.6. Fire up your favorite IDE, create a blank project, and let's get started! We will be using the limited ES6 syntax in Node, so we won't be configuring Babel.

NPM Install

Let's go to the project folder and initialize our project

```
npm init -y
```

Let's install Mongoose and a validation library with the following command:

```
npm install mongoose validator
```

The above install command will install the latest version of the libraries. The Mongoose syntax in this article is specific to Mongoose v5 and beyond.

Database Connection

Create a file `./src/database.js` under the project root.

Next, we will add a simple class with a method that connects to the database.

Your connection string will vary based on your installation.

```
let mongoose = require('mongoose');

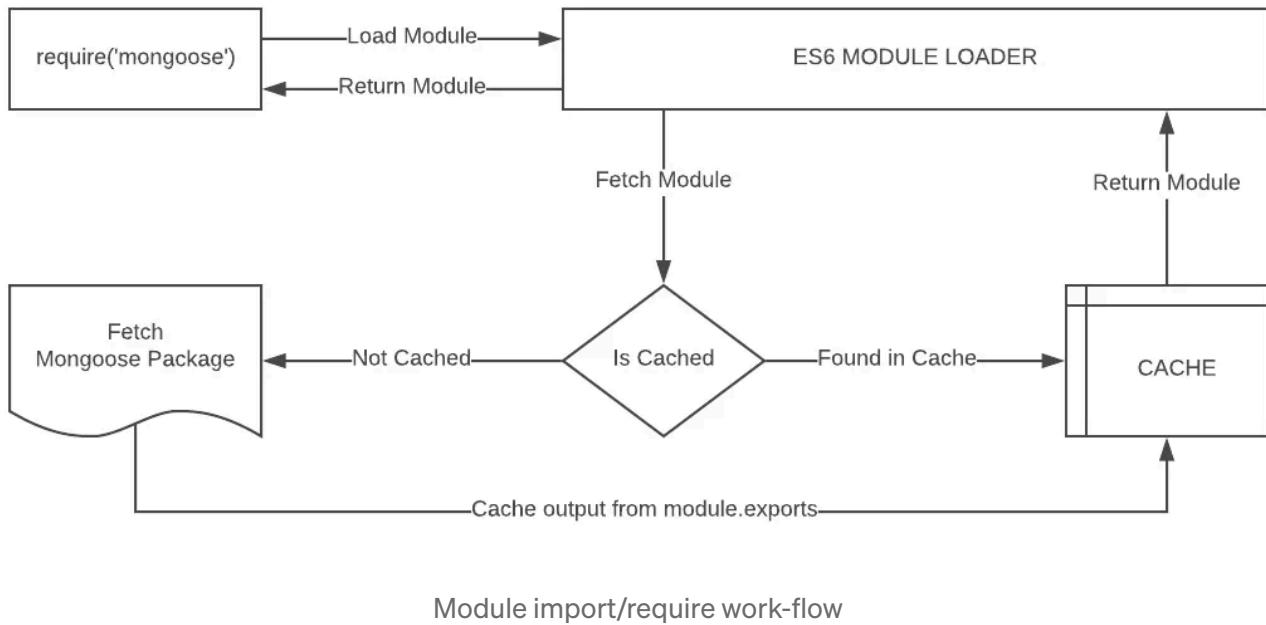
const server = '127.0.0.1:27017'; // REPLACE WITH YOUR DB SERVER
const database = 'fcc-Mail'; // REPLACE WITH YOUR DB NAME

class Database {
  constructor() {
    this._connect()
  }

  _connect() {
    mongoose.connect(`mongodb://${server}/${database}`)
      .then(() => {
        console.log('Database connection successful')
      })
      .catch(err => {
        console.error('Database connection error')
      })
  }
}

module.exports = new Database()
```

The `require('mongoose')` call above returns a Singleton object. It means that the first time you call `require('mongoose')`, it is creating an instance of the Mongoose class and returning it. On subsequent calls, it will return the same instance that was created and returned to you the first time because of how module import/export works in ES6.



Similarly, we have turned our Database class into a singleton by returning an instance of the class in the `module.exports` statement because we only need a single connection to the database.

ES6 makes it very easy for us to create a singleton (single instance) pattern because of how the module loader works by caching the response of a previously imported file.

Mongoose Schema vs. Model

A Mongoose model is a wrapper on the Mongoose schema. A Mongoose schema defines the structure of the document, default values, validators, etc., whereas a Mongoose model provides an interface to the database for creating, querying, updating, deleting records, etc.

Creating a Mongoose model comprises primarily of three parts:

1. Referencing Mongoose

```
let mongoose = require('mongoose')
```

This reference will be the same as the one that was returned when we connected to the database, which means the schema and model definitions will not need to explicitly connect to the database.

2. Defining the Schema

A schema defines document properties through an object where the key name corresponds to the property name in the collection.

```
let emailSchema = new mongoose.Schema({  
  email: String  
})
```

Here we define a property called `email` with a schema type `String` which maps to an internal validator that will be triggered when the model is saved to the database. It will fail if the data type of the value is not a string type.

The following Schema Types are permitted:

- Array
- Boolean
- Buffer
- Date
- Mixed (A generic / flexible data type)
- Number
- ObjectId
- String

Mixed and ObjectId are defined under `require('mongoose').Schema.Types`.

3. Exporting a Model

We need to call the model constructor on the Mongoose instance and pass it the name of the collection and a reference to the schema definition.

```
module.exports = mongoose.model('Email', emailSchema)
```

Let's combine the above code into `./src/models/email.js` to define the contents of a basic email model:

```
let mongoose = require('mongoose')

let emailSchema = new mongoose.Schema({
  email: String
})

module.exports = mongoose.model('Email', emailSchema)
```

A schema definition should be simple, but its complexity is usually based on application requirements. Schemas can be reused and they can contain several child-schemas too. In the example above, the value of the email property is a simple value type. However, it can also be an object type with additional properties on it.

We can create an instance of the model we defined above and populate it using the following syntax:

```
let EmailModel = require('./email')

let msg = new EmailModel({
  email: 'ada.lovelace@gmail.com'
})
```

Let's enhance the Email schema to make the email property a unique, required field and convert the value to lowercase before saving it. We can also add a validation function that will ensure that the value is a valid email address. We will reference and use the validator library installed earlier.

```
let mongoose = require('mongoose')
let validator = require('validator')

let emailSchema = new mongoose.Schema({
  email: {
    type: String,
    required: true,
    unique: true,
    lowercase: true,
    validate: (value) => {
      return validator.isEmail(value)
    }
  }
})

module.exports = mongoose.model('Email', emailSchema)
```

Basic Operations

Mongoose has a flexible API and provides many ways to accomplish a task. We will not focus on the variations because that is out of scope for this article, but remember that most of the operations can be done in more than one way either syntactically or via the application architecture.

Create Record

Let's create an instance of the email model and save it to the database:

```
let EmailModel = require('./email')

let msg = new EmailModel({
  email: 'ADA.LOVELACE@GMAIL.COM'
})

msg.save()
  .then(doc => {
    console.log(doc)
  })
  .catch(err => {
    console.error(err)
  })
```

The result is a document that is returned upon a successful save:

```
{
  _id: 5a78fe3e2f44ba8f85a2409a,
  email: 'ada.lovelace@gmail.com',
  __v: 0
}
```

The following fields are returned (internal fields are prefixed with an underscore):

1. The `_id` field is auto-generated by Mongo and is a primary key of the collection. Its value is a unique identifier for the document.
2. The value of the `email` field is returned. Notice that it is lower-cased because we specified the `lowercase:true` attribute in the schema.
3. `__v` is the `versionKey` property set on each document when first created by Mongoose. Its value contains the internal revision of the document.

If you try to repeat the save operation above, you will get an error because we have specified that the email field should be unique.

Fetch Record

Let's try to retrieve the record we saved to the database earlier. The model class exposes several static and instance methods to perform operations on the database. We will now try to find the record that we created previously using the find method and pass the email as the search term.

```
EmailModel
  .find({
    email: 'ada.lovelace@gmail.com'    // search query
  })
  .then(doc => {
    console.log(doc)
  })
  .catch(err => {
    console.error(err)
  })
}
```

The document returned will be similar to what was displayed when we created the record:

```
{
  _id: 5a78fe3e2f44ba8f85a2409a,
  email: 'ada.lovelace@gmail.com',
  __v: 0
}
```

Update Record

Let's modify the record above by changing the email address and adding another field to it, all in a single operation. For performance reasons, Mongoose won't return the updated document so we need to pass an additional parameter to ask for it:

```
EmailModel
  .findOneAndUpdate(
  {
    email: 'ada.lovelace@gmail.com'    // search query
  },
  {
    // update object
  }
}
```

```

    email: 'theoutlander@live.com' // field:values to update
  },
  {
    new: true, // return updated doc
    runValidators: true // validate before update
  })
.then(doc => {
  console.log(doc)
})
.catch(err => {
  console.error(err)
})

```

The document returned will contain the updated email:

```
{
  _id: 5a78fe3e2f44ba8f85a2409a,
  email: 'theoutlander@live.com',
  __v: 0
}
```

Delete Record

We will use the `findOneAndRemove` call to delete a record. It returns the original document that was removed:

```

EmailModel
  .findOneAndRemove({
    email: 'theoutlander@live.com'
  })
  .then(response => {
    console.log(response)
  })
  .catch(err => {
    console.error(err)
  })

```

Helpers

We have looked at some of the basic functionality above known as CRUD (Create, Read, Update, Delete) operations, but Mongoose also provides the ability to configure several types of helper methods and properties. These can be used to further simplify working with data.

Let's create a user schema in `./src/models/user.js` with the fields `firstName` and `lastName`:

```
let mongoose = require('mongoose')

let userSchema = new mongoose.Schema({
  firstName: String,
  lastName: String
})

module.exports = mongoose.model('User', userSchema)
```

Virtual Property

A virtual property is not persisted to the database. We can add it to our schema as a helper to get and set values.

Let's create a virtual property called `fullName` which can be used to set values on `firstName` and `lastName` and retrieve them as a combined value when read:

```
userSchema.virtual('fullName').get(function() {
  return this.firstName + ' ' + this.lastName
})

userSchema.virtual('fullName').set(function(name) {
  let str = name.split(' ')
  this.firstName = str[0]
  this.lastName = str[1]
})
```

Callbacks for get and set must use the function keyword as we need to access the model via the `this` keyword. Using fat arrow functions will change what `this` refers to.

Now, we can set `firstName` and `lastName` by assigning a value to `fullName`:

```
let model = new UserModel()
model.fullName = 'Thomas Anderson'
```

```
console.log(model.toJSON()) // Output model fields as JSON
console.log()
console.log(model.fullName) // Output the full name
```

The code above will output the following:

```
{ _id: 5a7a4248550ebb9fafd898cf,
  firstName: 'Thomas',
  lastName: 'Anderson' }
```

Thomas Anderson

Instance Methods

We can create custom helper methods on the schema and access them via the model instance. These methods will have access to the model object and they can be used quite creatively. For instance, we could create a method to find all the people who have the same first name as the current instance.

In this example, let's create a function to return the initials for the current user. Let's add a custom helper method called `getInitials` to the schema:

```
userSchema.methods.getInitials = function() {
  return this.firstName[0] + this.lastName[0]
}
```

This method will be accessible via a model instance:

```
let model = new UserModel({
  firstName: 'Thomas',
  lastName: 'Anderson'
})

let initials = model.getInitials()
console.log(initials) // This will output: TA
```

Static Methods

Similar to instance methods, we can create static methods on the schema. Let's create a method to retrieve all users in the database:

```

userSchema.statics.getUsers = function() {
  return new Promise((resolve, reject) => {
    this.find((err, docs) => {
      if(err) {
        console.error(err)
        return reject(err)
      }

      resolve(docs)
    })
  })
}

```

Calling `getUsers` on the Model class will return all the users in the database:

```

UserModel.getUsers()
  .then(docs => {
    console.log(docs)
  })
  .catch(err => {
    console.error(err)
  })
}

```

Adding instance and static methods is a nice approach to implement an interface to database interactions on collections and records.

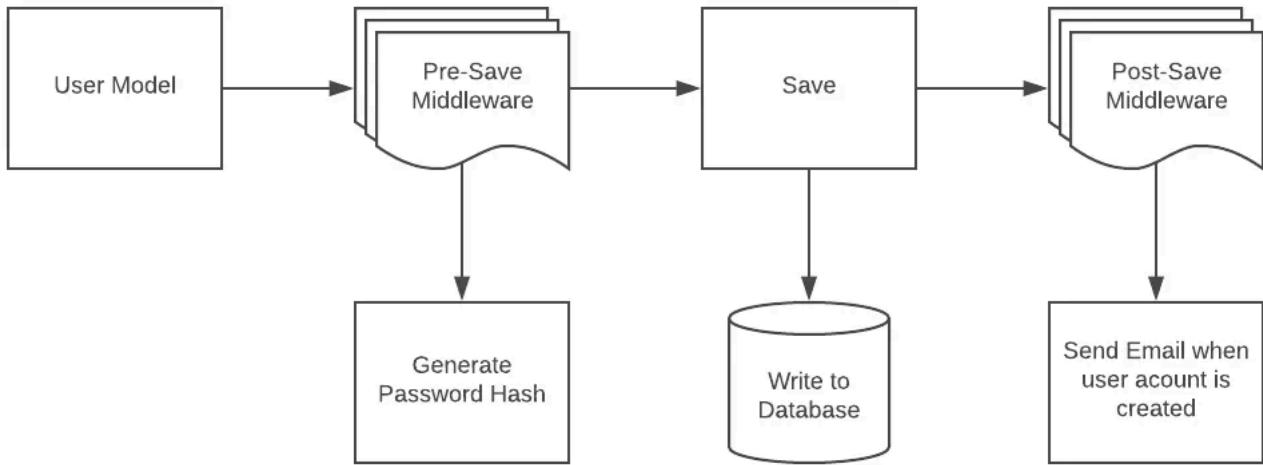
Middleware

Middleware are functions that run at specific stages of a pipeline. Mongoose supports middleware for the following operations:

- Aggregate
- Document
- Model
- Query

For instance, models have `pre` and `post` functions that take two parameters:

1. Type of event ('init', 'validate', 'save', 'remove')
2. A callback that is executed with `this` referencing the model instance



Example of Middleware (a.k.a. pre and post hooks)

Let's try an example by adding two fields called `createdAt` and `updatedAt` to our schema:

```

let mongoose = require('mongoose')

let userSchema = new mongoose.Schema({
  firstName: String,
  lastName: String,
  createdAt: Date,
  updatedAt: Date
})

module.exports = mongoose.model('User', userSchema)
  
```

When `model.save()` is called, there is a `pre('save', ...)` and `post('save', ...)` event that is triggered. For the second parameter, you can pass a function that is called when the event is triggered. These functions take a parameter to the next function in the middleware chain.

Let's add a pre-save hook and set values for `createdAt` and `updatedAt`:

```

userSchema.pre('save', function (next) {
  let now = Date.now()

  this.updatedAt = now
  
```

```
// Set a value for createdAt only if it is null
if (!this.createdAt) {
  this.createdAt = now
}

// Call the next function in the pre-save chain
next()
})
```

Let's create and save our model:

```
let UserModel = require('./user')

let model = new UserModel({
  fullName: 'Thomas Anderson'
})

msg.save()
  .then(doc => {
    console.log(doc)
  })
  .catch(err => {
    console.error(err)
  })
```

You should see values for `createdAt` and `updatedAt` when the record that is created is printed:

```
{ _id: 5a7bbbeebc3b49cb919da675,
  firstName: 'Thomas',
  lastName: 'Anderson',
  updatedAt: 2018-02-08T02:54:38.888Z,
  createdAt: 2018-02-08T02:54:38.888Z,
  __v: 0 }
```

Plugins

Suppose that we want to track when a record was created and last updated on every collection in our database. Instead of repeating the above process, we can create a plugin and apply it to every schema.

Let's create a file `./src/model/plugins/timestamp.js` and replicate the above functionality as a reusable module:

```
module.exports = function timestamp(schema) {

    // Add the two fields to the schema
    schema.add({
        createdAt: Date,
        updatedAt: Date
    })

    // Create a pre-save hook
    schema.pre('save', function (next) {
        let now = Date.now()

        this.updatedAt = now

        // Set a value for createdAt only if it is null
        if (!this.createdAt) {
            this.createdAt = now
        }

        // Call the next function in the pre-save chain
        next()
    })
}
```

To use this plugin, we simply pass it to the schemas that should be given this functionality:

```
let timestampPlugin = require('./plugins/timestamp')

emailSchema.plugin(timestampPlugin)
userSchema.plugin(timestampPlugin)
```

Query Building

Mongoose has a very rich API that handles many complex operations supported by MongoDB. Consider a query where we can incrementally build query components.

In this example, we are going to:

1. Find all users
2. Skip the first 100 records
3. Limit the results to 10 records
4. Sort the results by the firstName field

5. Select the firstName

6. Execute that query

```
UserModel.find()          // find all users
    .skip(100)           // skip the first 100 items
    .limit(10)           // limit to 10 items
    .sort({firstName: 1}) // sort ascending by firstName
    .select({firstName: true}) // select firstName only
    .exec()              // execute the query
    .then(docs => {
        console.log(docs)
    })
    .catch(err => {
        console.error(err)
    })
}
```

Closing

We have barely scratched the surface exploring some of the capabilities of Mongoose. It is a rich library full of useful and powerful features that make it a joy to work with data models in the application layer.

While you can interact with Mongo directly using Mongo Driver, Mongoose will simplify that interaction by allowing you to model relationships between data and validate them easily.

Fun Fact: Mongoose is created by Valeri Karpov who is an incredibly talented engineer! He coined the term The MEAN Stack.

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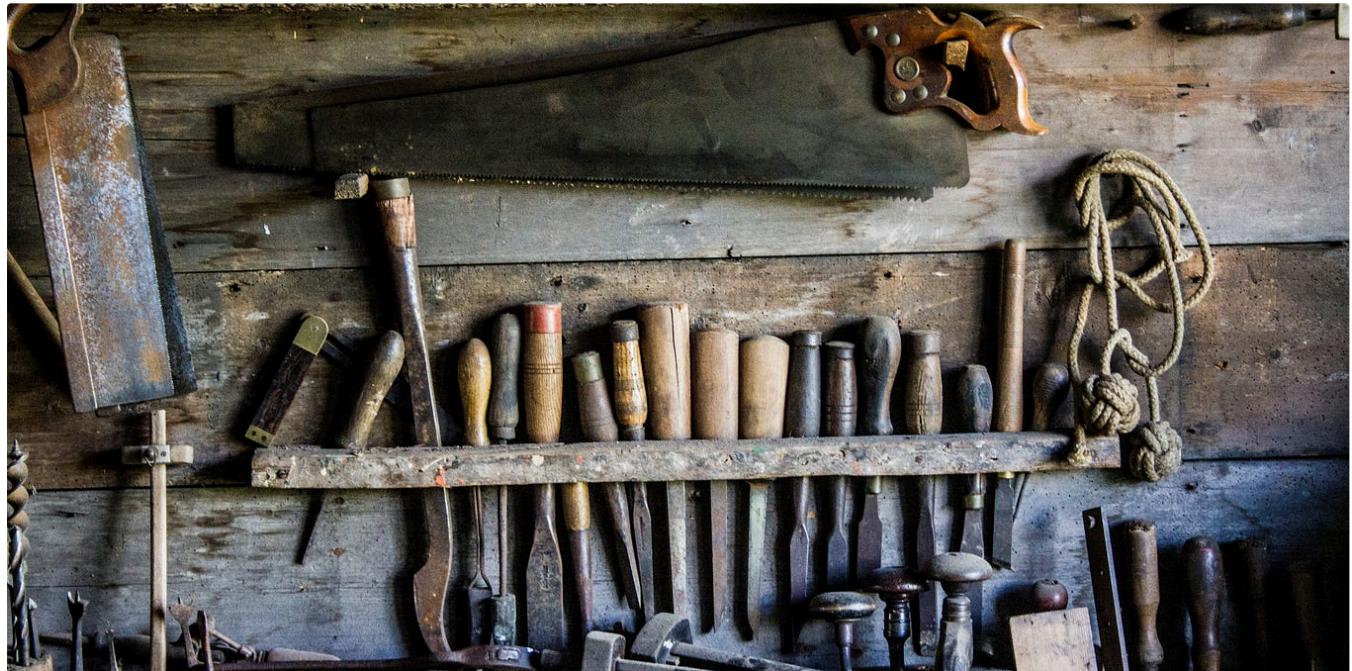
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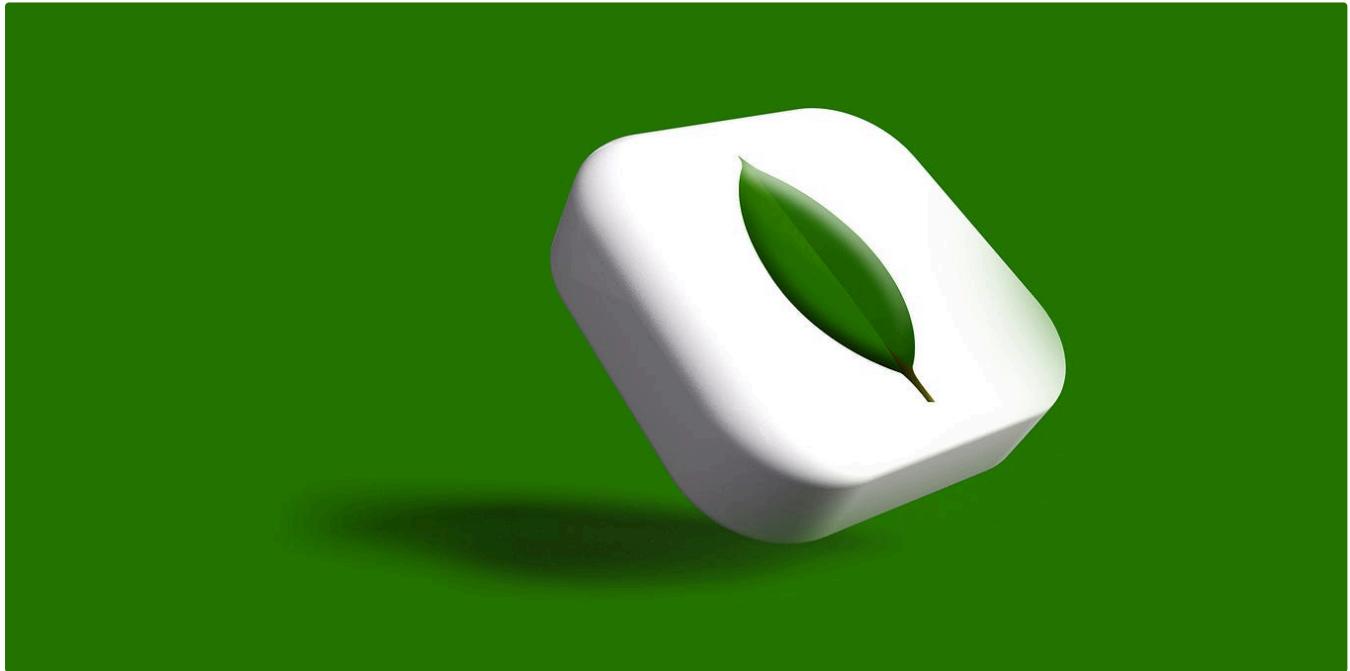
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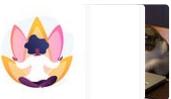
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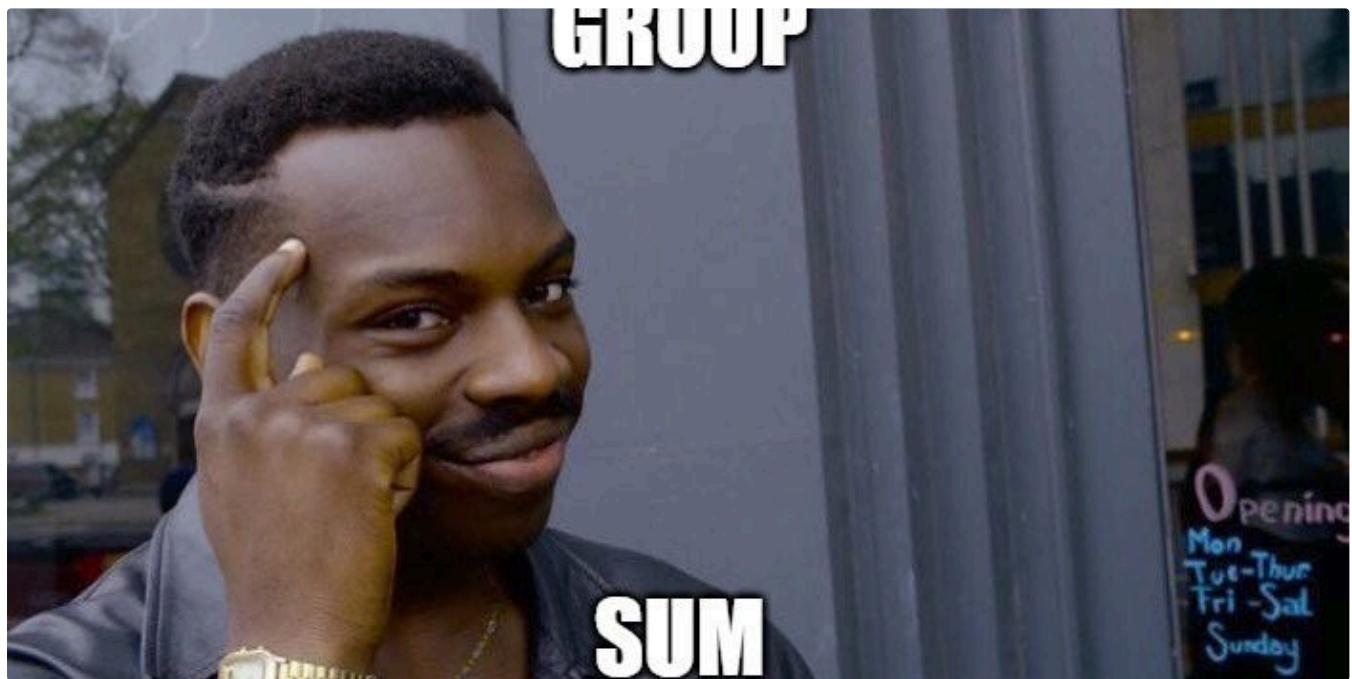
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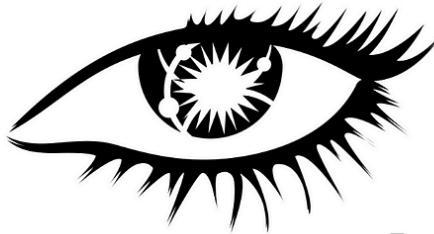
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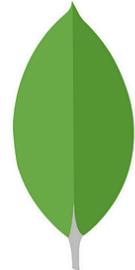
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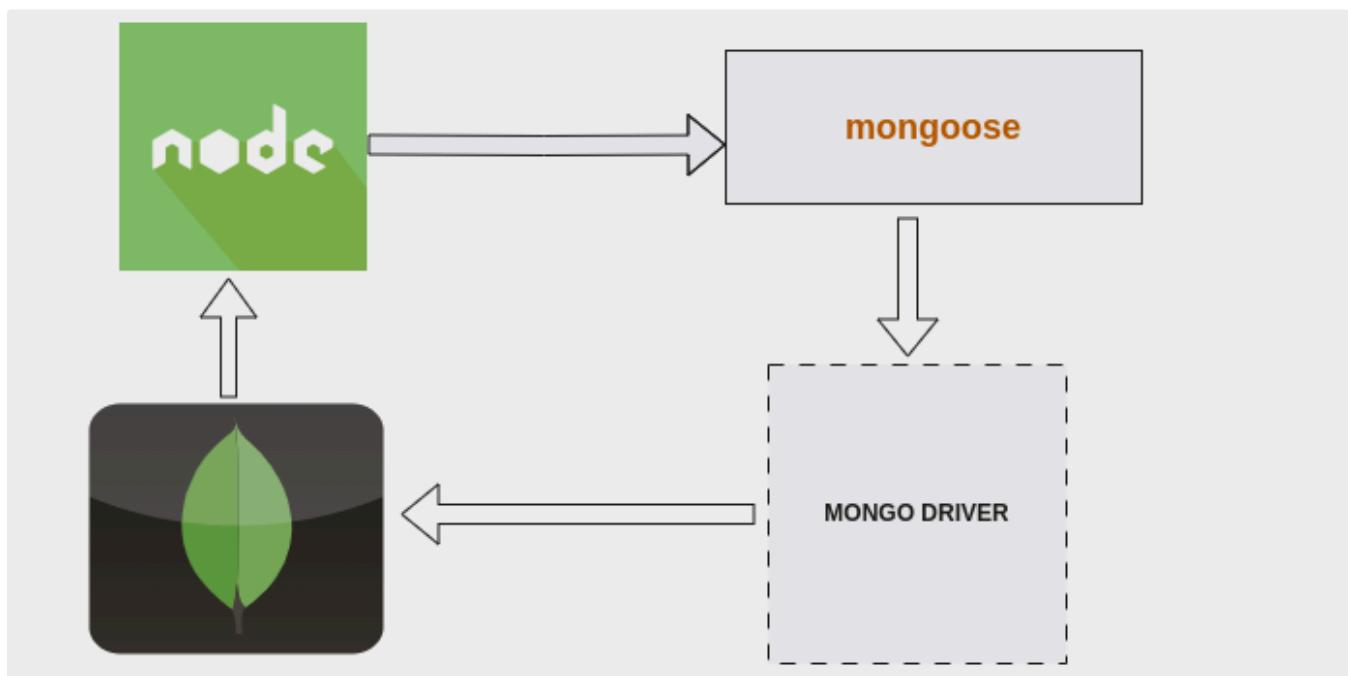
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