



MongoDB, Mongoose and Cloud Storage

Frank Walsh, Diarmuid O'Connor

Agenda

- NoSQL Databases
- MongoDB
- Mongoose
- Mongo in the cloud



Databases in Enterprise Apps

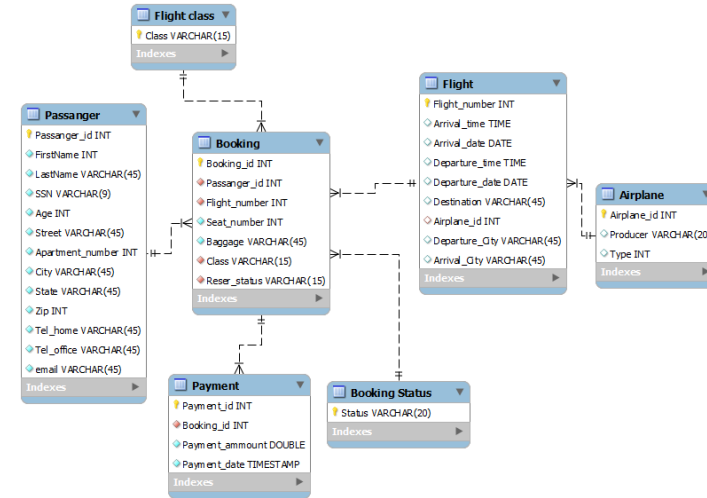
- Most data driven enterprise applications need a database
 - Persistence: storage of data
 - Concurrency: many applications sharing the data at once.
 - Integration: multiple systems using the same DB
- Enterprise Application DBs require backups, fail over, maintenance, capacity provisioning.
 - Traditionally handled by a Database Administrator (the DBA).



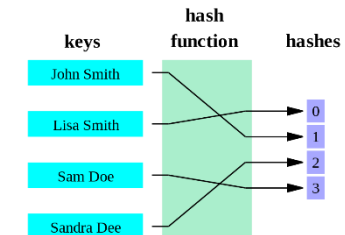
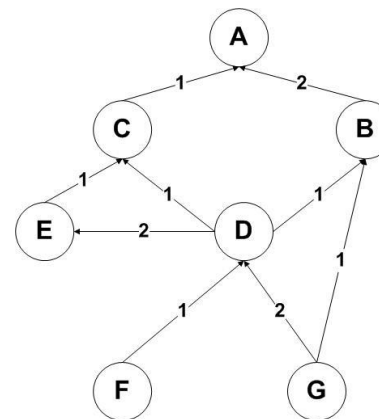
Structured & Unstructured Data

- Relational Databases:
 - Organise data into structured tables and rows
 - Relations have to be simple, they cannot contain any structure such as a nested record or a list
- In memory data structures
 - Much more varied structure
 - Lists, Queues, Stacks, Graphs, Hashing

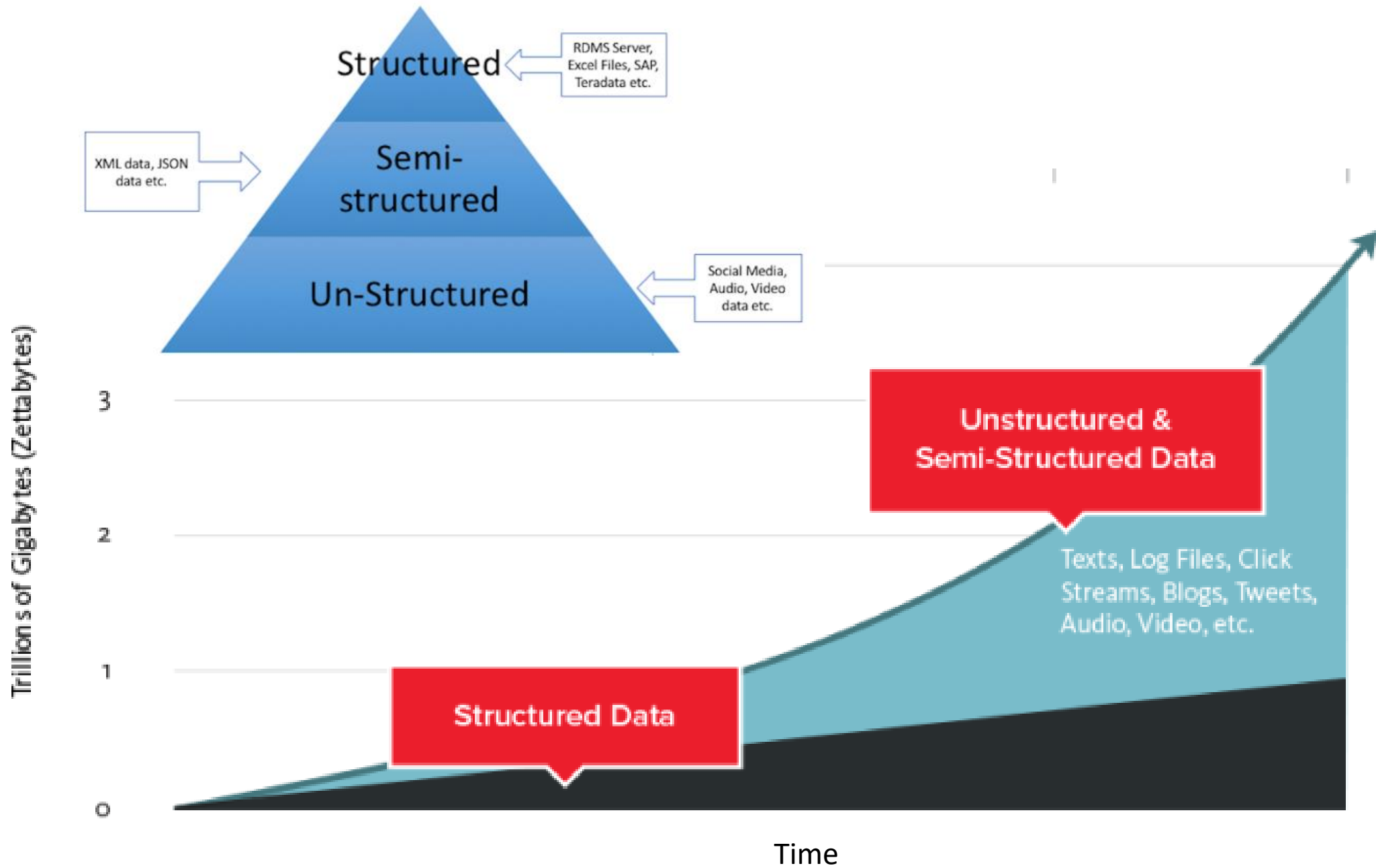
Relational Database



In Memory Data Structures

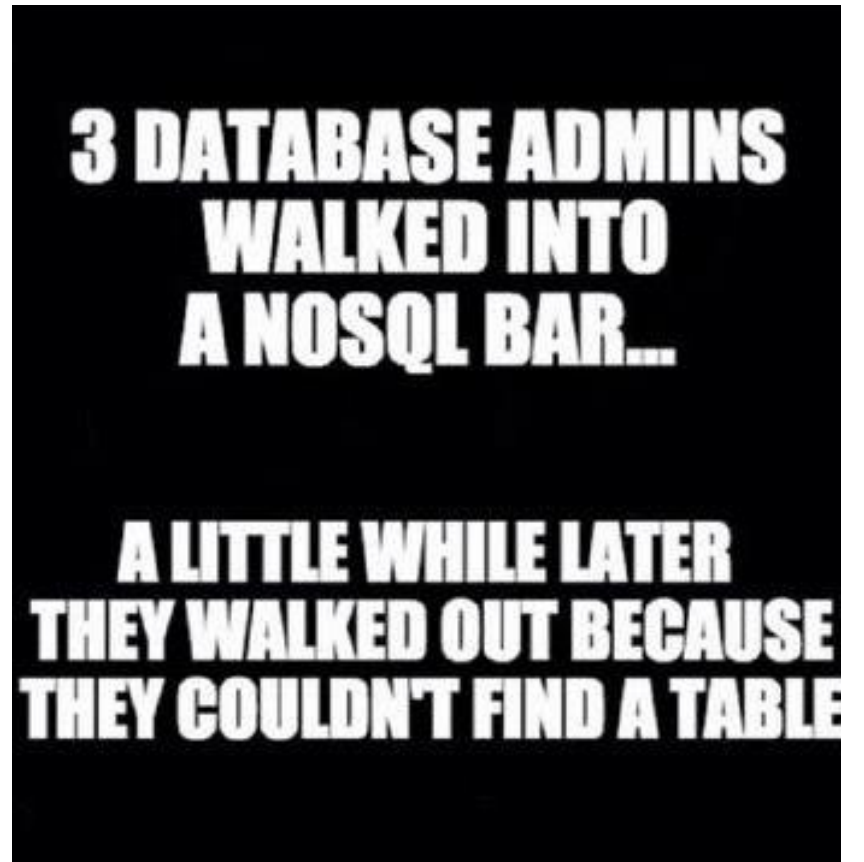


data format



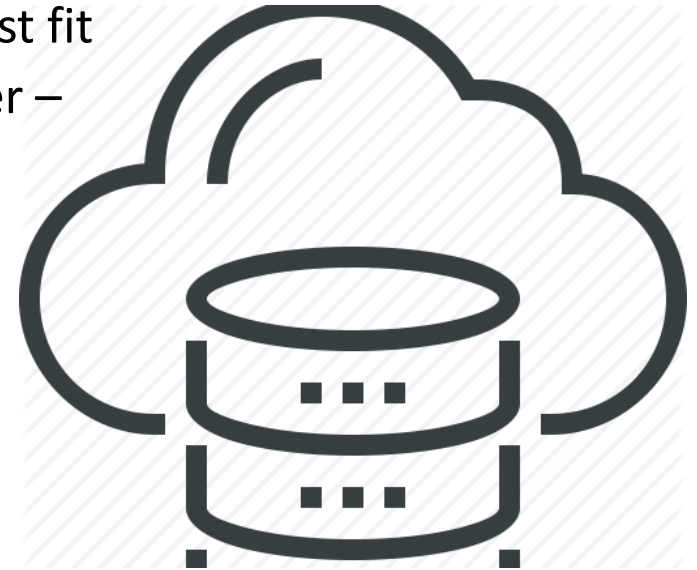
NoSQL Databases

- Non-tabular(no tables) databases and store data differently than relational tables.
- Variety of types based on their data model
 - Document based, key-value based graph
- NoSQL databases allow developers to work with semi-structured/unstructured data, giving them a lot of flexibility
- No need to define exact schema(i.e. structure) for data



Databases in the Cloud

- For some apps, a traditional relational database may not be the best fit
 - Organisations are capturing more data and processing it quicker – can be expensive/difficult on traditional DB
 - Traditionally, relational database is designed to run on a single machine in predictable environment
 - May be economic to run large data and computing loads on clusters.
 - Hard to estimate scaling requirements, particularly if it's a web app?
 - Are you going to do Data mining?
- One approach is to use the **Cloud** for your DB
 - Designed for scale
 - Can be outsourced so you don't have to deal with infrastructure requirements.



NoSQL Cloud DB Advantages

- Removes Management costs
- Inherently scalable
- No need to define schemas(if NoSQL) etc.
- Lots of Cloud DB offerings out there
 - SQL based
 - NoSQL based
- If organisation policy/standards do not allow outsourcing:
 - Can host yourself, most NoSQL DBs are free.

Cloud Database Practices

- Drop Consistency(if you can)
 - this makes distributed systems much easier to build
- Drop SQL and the relational model
 - simpler structures are easier to distribute:
 - key/value pairs
 - **structured documents**
 - **pseudo-tables**
 - tend to be schema-free, accepting data as-is
- Offer HTTP interfaces using XML or **JSON**
 - Web APIs!!!



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MONGODB

Introduction

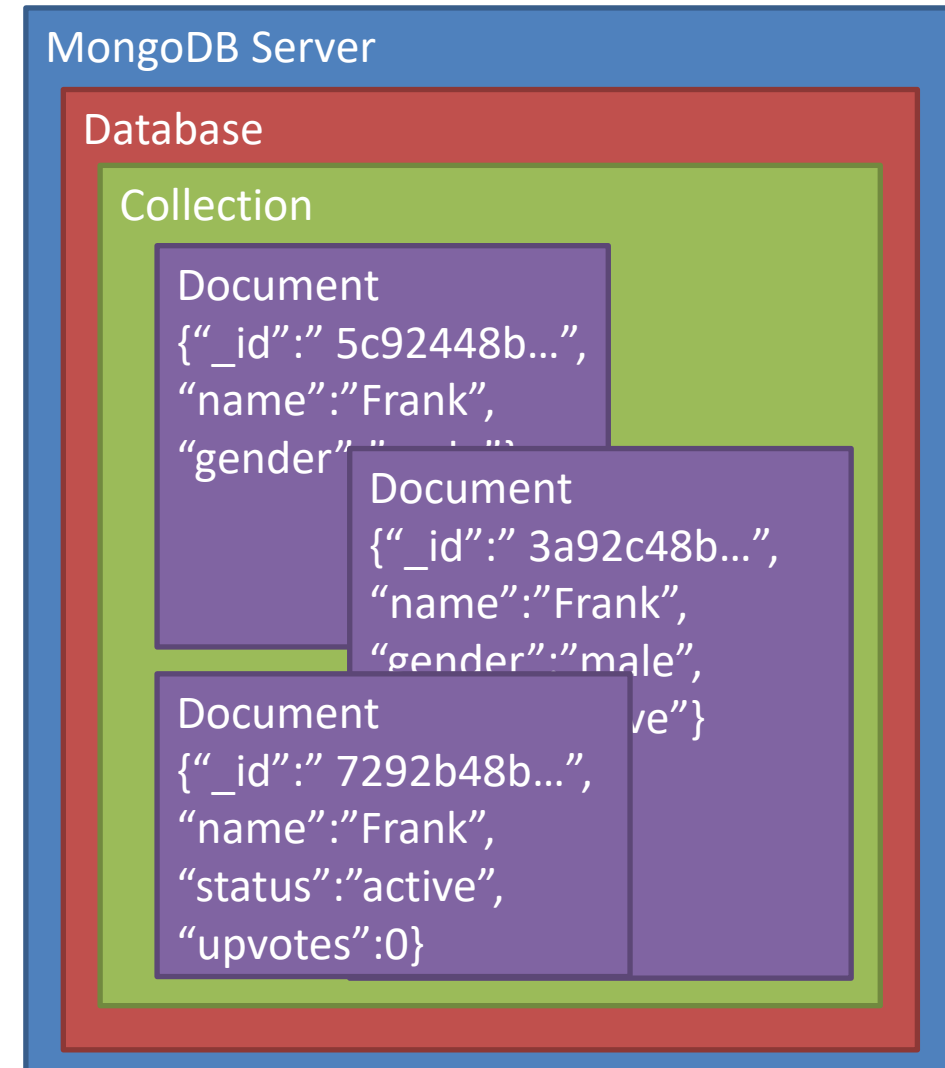
- Document-oriented database
- A record in MongoDB is a document, which is a data structure composed of field and value pairs.
- MongoDB documents are similar to JSON objects
- Field Values can be other documents, arrays, arrays of other documents.
 - Reduces need for “Joins”
- Community support - popular choice

```
{  
  name: "sue",  
  age: 26,  
  status: "A",  
  groups: [ "news", "sports" ]  
}
```



Mongo Terminology

- Each **database** contains a set of "Collections"
- Collections contain a set of JSON documents
 - there is no schema (in the DB...)
- The documents can all be different
 - means you have rapid development
 - adding a property is easy - just starting using in your code
- Makes deployment easier and faster
 - roll-back and roll-forward are safe - unused properties are just ignored
- Collections can be indexed and queries
- Operations on individual documents are atomic




Mongo Documents

- MongoDB stores data records as **BSON** documents.
 - BSON is a binary representation of JSON documents.
- Each document stored in a collection requires a unique ***_id*** field and is reserved for use as a primary key.
- If an inserted document omits the **_id** field, the MongoDB driver automatically generates an ObjectId for the ***_id*** field.
 - ObjectId values consist of 12 bytes.

```
_id: ObjectId("5c92448b7fbccf28a0c501aa")  
name: "Contact 4"  
address: "49 Upper Street"  
phone_number: "934-4290"
```

Getting Started (locally)

- Install Mongo community edition for your OS:

[Install MongoDB](#) > Install MongoDB Community Edition 

Install MongoDB Community Edition

These documents provide instructions to install MongoDB Community Edition.

[Install on Linux](#)
Install MongoDB Community Edition and required dependencies on Linux.

[Install on macOS](#)
Install MongoDB Community Edition on macOS systems from MongoDB archives.

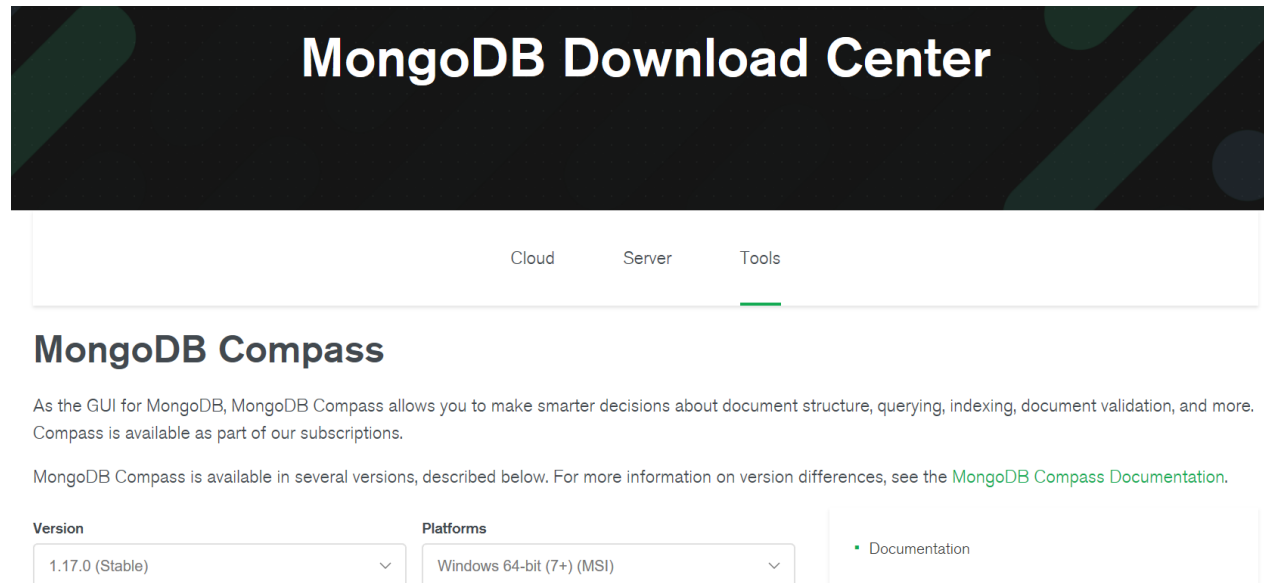
[Install on Windows](#)
Install MongoDB Community Edition on Windows systems and optionally start MongoDB as a Windows service.

- Specify a directory for your db files and start Mongodb server.

```
mkdir db  
mongod -dbpath db
```

Getting Started (locally)

- Install Mongo Compass, Graphical User Interface for managing MongoDB.
 - For windows, comes as part of mongodb install
 - Other platforms can get it [here](#):





MONGOOSE

Mongo with Node.js

Mongoose Overview

- Mongoose is a object-document model module in Node.js for MongoDB
 - Wraps the functionality of the native MongoDB driver
 - Exposes models to control the records in a doc
 - Supports validation on save
 - Extends the native queries

mongoose

elegant **mongodb** object modeling for **node.js**

[read the docs](#)[discover plugins](#)[Star](#) 18,205

Version 5.4.19

[Fork](#) 2,570

Let's face it, **writing MongoDB validation, casting and business logic boilerplate is a drag**. That's why we wrote Mongoose.

Mongoose first?

- Shortcut to understanding the basics
- Similar to Object Relational Mapping libraries like JPA/Hibernate
- Easier concept if coming from relational DB background.



Installing & Using Mongoose

1. Run the following from the CMD/Terminal

```
npm install --save mongoose
```

2. Import the module

```
import mongoose from 'mongoose';
```

3. Connect to the database

```
mongoose.connect(process.env.mongoose);
```

Mongoose Schemas and Models

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

```
import mongoose from 'mongoose';

const Schema = mongoose.Schema;

const UserSchema = new Schema({
  username: { type: String, unique: true, required: true },
  password: { type: String, required: true }
});

export default mongoose.model('User', UserSchema);
```

Demo

- Contacts API: Manage contact details...

Contacts Schema:

name: String

address: String

age: Number

email: String

updated: Date

Solution in Code Examples...

Sub Documents

Validators

Queries

Object Refs.

LECTURE 2

Mongoose Schemas – Arrays & sub-documents

Example: Data Model for supports user Posts on a web site:

Comments property is
an Array of
CommentSchemas

Title: Check the Dune movie trailer
Link: <http://dunethemovie.com>
username:fxwalsh
upvotes:20
comments:

body: Wow Looks Great!!!
author: JPrithet
upvotes: 0

body: When is it out?
author: BHope
upvotes: 0

body: Original is better!
author: MPower
upvotes: 0

```
1 |const mongoose = require('mongoose'),
2 |Schema = mongoose.Schema;
3
4 |const CommentSchema = new Schema({
5 |  body: {type: String, required:true},
6 |  author: {type: String, required:true},
7 |  upvotes:Number
8 |});
9
10|const PostSchema = new Schema({
11|  title: {type: String, required:true},
12|  link: {type: String, optional:true},
13|  username: {type: String, required:true},
14|  comments: [CommentSchema],
15|  upvotes: { type: Number, min: 0, max: 100 }
16|});
17
18|export default mongoose.model('posts', PostSchema);
```

Mongoose Schemas - Arrays

```
import mongoose from 'mongoose';

const Schema = mongoose.Schema;

const MovieReviewSchema = {
  userName : { type: String},
  review : {type: String}
}

const MovieSchema = new Schema({
  adult: { type: Boolean},
  id: { type: Number, required: true, unique: true },
  poster_path: { type: String},
  overview: { type: String},
  release_date: { type: String},
  reviews : [ MovieReviewSchema],
  original_title: { type: String},
  genre_ids: [{type: Number}],
```

Review property is an
Array of
MovieReviewSchema

Mongoose Schema – Built-in Validation

constraints on properties :

```
import mongoose from 'mongoose';
const Schema = mongoose.Schema;

const ContactSchema = new Schema({
  name: {type: String, required:[true, 'Name is a required property']},
  address: String,
  age: {
    type: Number,
    min: 0,
    max: 120,required: true
  },
  email: String,
  updated: {
    type: Date,
    default: Date.now,
  },
});

export default mongoose.model('Contact', ContactSchema);
```

```
import mongoose from 'mongoose';

const Schema = mongoose.Schema;

const UserSchema = new Schema({
  username: { type: String, unique: true, required: true},
  password: {type: String, required: true }
});

export default mongoose.model('User', UserSchema);
```

Mongoose Custom Validation

- Developers can define custom validation on their properties (e.g. validate name field is correct format)

```
//Make sure name starts with capital letter,  
const nameValidator = (name) => {  
  let nameRegex = /\b([A-ZÀ-ÿ](-,a-z. ')+[ ]*)+/;  
  return nameRegex.test(name);  
};  
  
ContactSchema.path('name').validate(nameValidator);
```

Using Regular Expression (regex) to test for a valid name format, for example begins with a capital letter. If you've not come across them before check out https://www.w3schools.com/jsref/jsref_obj_regexp.asp

Data Manipulation Mongoose

- Mongoose supports all the CRUD operations:
 - **Create** → `Model.create(docs)` or `new Model(doc).save()`
 - **Read** → `Model.find(conditions)`
 - **Update** → `Model.update(conditions, props)`
 - **Remove** → `Model.remove(conditions)`
- Can operate with "*error first*" callbacks, promises, or `async-await`

Create with Mongoose (async-await)

```
import mongoose from 'mongoose';
const Schema = mongoose.Schema;

const ContactSchema = new Schema({
  name: { type: String, required: true },
  address: String,
  age: {
    type: Number,
    min: 0,
    max: 120,
    required: true
  },
  email: String,
  updated: {
    type: Date,
    default: Date.now
  }
});

export default mongoose.model('Contact', ContactSchema);
```

api \ contacts

- JS contactModel.js
- JS index.js

```
import express from 'express';
import Contact from './contactModel';

const router = express.Router();

// add a contact (simple - no validation or body checking)
router.post('/', async (req, res) => {
  const newContact = await new Contact(req.body).save();
  res.status(201).json(newContact);
});
```

Create with Mongoose (promise)

```
import mongoose from 'mongoose';
const Schema = mongoose.Schema;

const ContactSchema = new Schema({
  name: { type: String, required: true },
  address: String,
  age: {
    type: Number,
    min: 0,
    max: 120,
    required: true
  },
  email: String,
  updated: {
    type: Date,
    default: Date.now
  }
});

export default mongoose.model('Contact', ContactSchema);
```

api \ contacts

- JS contactModel.js
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```
import express from 'express';
import Contact from './contactModel';

const router = express.Router();

// add a contact (simple - no validation or body checking)
router.post('/', (req, res) => {
  new Contact(req.body).save()
    .then(contact => res.status(201).json(contact));
});
```

Update with Mongoose

- Async-Await Syntax

```
router.put('/:id', async (req, res, next) => {  
  if (req.body._id) delete req.body._id;  
  const query = { _id: req.params.id };  
  const result = await Contact.update(query, req.body);  
  res.status(201).json(result);  
});  
  
export default router;
```

- Promise Syntax

```
router.put('/:id', (req, res, next) => {  
  if (req.body._id) delete req.body._id;  
  const query = { _id: req.params.id };  
  Contact.update(query, req.body)  
    .then(contact => res.status(201).json(contact));  
});
```

Mongoose Queries

- Mongoose supports many queries:
 - For equality/non-equality
 - Selection of some properties
 - Sorting
 - Limit & skip
- Mongoose models provide several static helper functions for CRUD operations.
 - `Model.findOne()` returns a single document, the first match
 - `Model.find()` returns all
 - `Model.findById()` queries on the `_id` field.

- `Model.deleteMany()`
- `Model.deleteOne()`
- `Model.find()`
- `Model.findById()`
- `Model.findByIdAndDelete()`
- `Model.findByIdAndRemove()`
- `Model.findByIdAndUpdate()`
- `Model.findOne()`
- `Model.findOneAndDelete()`
- `Model.findOneAndRemove()`
- `Model.findOneAndReplace()`
- `Model.findOneAndUpdate()`
- `Model.replaceOne()`
- `Model.updateMany()`
- `Model.updateOne()`

Mongoose Queries

- Can build complex queries and execute them later

```
1  const query = ContactModel.where('age').gt(17).lt(66)
2    .where('county').in(['Waterford', 'Wexford', 'Kilkenny']);
3
4  query.exec((err, contacts) => {...})
5
6
```

- The above finds all contacts where age >17 and <66 and living in either Waterford, Kilkenny or Wexford

Object Referencing

- Can use Object Id to reference documents in other collections
- Similar to 'foreign keys' in SQL databases

Using Object ID to
reference a
document in
Products

```
const ContactSchema = new Schema({
  name: { type: String, required: true },
  address: String,
  age: {
    type: Number,
    min: 0,
    max: 120,
    required: true
  },
  email: String,
  updated: {
    type: Date,
    default: Date.now
  },
  productsPurchased: [{type: mongoose.Schema.Types.ObjectId, ref: 'Products'}]
});
```

Query Population using Refs

<https://github.com/fxwalsh/ewd-examples-2020.git>

- Allows you to automatically replace the specified paths in the document with document(s) from other collection(s).

```
//Demo of Referencing in Mongoose: Error handling left out to simplify code.
//to run, type npx babel-node ref_example.js at the command line.

const createData = async () => {
  //Create a product
  const product1 = await new Product({
    productName: "PS5",
    productCode: "X123456"
  }).save();

  //Create contact and add product IDs
  const contact1 = await new Contact({
    name: "Frank Walsh",
    age: 22,
    productsPurchased: [product1._id]
  }).save();

  //query db for contact and populate user field
  const contact = await Contact.findById(contact1._id).populate('productsPurchased');
  console.log(JSON.stringify(contact, null, "\t"));
}
```

output

```
{
  "productsPurchased": [
    {
      "_id": "5fc8d72bdf5a440d7c003be4",
      "productName": "PS5",
      "productCode": "X123456",
      "__v": 0
    }
  ],
  "_id": "5fc8d72bdf5a440d7c003be5",
  "name": "Frank Walsh",
  "age": 22,
  "updated": "2020-12-03T12:16:43.336Z",
  "__v": 0
}
```

SCHEMA METHODS

Example: Using Schema Methods for Simple Authentication

- Restrict access to API (require authentication):
 - Create users schema with methods for
 - Finding users
 - Checking password
 - Use **express-session** middleware to create and manage user session (using cookies)
 - Create an authentication route to set up “session”
 - Create your own authentication middleware and place it on /api/movies route

Aside: Sessions

- Requests to Express apps are stand-alone by default
 - no request can be linked to another.
 - By default, no way to know if this request comes from client that already performed a request previously.
- Sessions are a mechanism that makes it possible to “know” who sent the request and to associate requests.
- Using Sessions, every user of you API is assigned a unique session:
 - Allows you to store state.
- The express-session module is middleware that provides sessions for Express apps.

express-session

1.15.6 • Public • Published a year ago

Readme

9 Depend

express-session

npm

v1.15.6

downloads

3M/m

build

passing

coverage

100%

Installation

a Node.js module available through the npm registry

command:

```
npm install express-session
```

1. User Schema with Static & Instance Methods

```
const UserSchema = new Schema({
  username: { type: String, unique: true, required: true },
  password: { type: String, required: true },
});

UserSchema.statics.findByUserName = function(username) {
  return this.findOne({ username: username });
};

UserSchema.methods.comparePassword = function(candidatePassword) {
  const isMatch = this.password === candidatePassword;
  if (!isMatch) {
    throw new Error('Password mismatch');
  }
  return this;
};

export default mongoose.model('User', UserSchema);
```

Static Method: belongs to schema. Independent of any document instance

Instance Method: belongs to a specific document instance.

2. express-session middleware

- Session middleware that stores session data on server-side
 - Puts a unique ID on client

```
npm install --save express-session
```

- Add to Express App middleware stack:

```
//session middleware
app.use(session({
  secret: 'ilikecake',
  resave: true,
  saveUninitialized: true
}));
```

3. Use User Route to authenticate

- Use **/api/user** to authenticate, passing username and password in HTTP body

/api/users/index.js

```
// authenticate a user, using async handler
router.post('/', asyncHandler(async (req, res) => {
  if (!req.body.username || !req.body.password) {
    res.status(401).send('authentication failed');
  } else {
    const user = await User.findByUserName(req.body.username);
    if (user.comparePassword(req.body.password)) {
      req.session.user = req.body.username;
      req.session.authenticated = true;
      res.status(200).end("authentication success!");
    } else {
      res.status(401).end('authentication failed');
    }
  }
});
```

Using static method to find User document

Using instance method to check password

/index.js

```
app.use('/api/users', usersRouter);
```


4. Add Authentication Middleware

authenticate.js

```
import User from '../api/users/userModel';  
// Authentication and Authorization Middleware  
export default async (req, res, next) => {  
  if (req.session) {  
    let user = await User.findByUserName(req.session.user);  
    if (!user)  
      return res.status(401).end('unauthorised');  
    next();  
  } else {  
    return res.status(401).end('unauthorised');  
  }  
};
```

Checks for user ID in session object.
If exists, called next middleware function, otherwise end req/res cycle with 401

index.js

```
import authenticate from './authenticate';  
  
app.use('/api/movies', authenticate, moviesRouter);
```

Authentication middleware applied on /api/movies route.