Experiment – 7: MongoDB

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1) **Aim:** To study CRUD operations in MongoDB
2) **Problem Statement:**
   A) Create a new database to storage student details of IT dept(Name, Roll no, class name) and perform the following on the database
      a) Insert one student details
      b) Insert at once multiple student details
      c) Display student for a particular class
      d) Display students of specific roll no in a class
      e) Change the roll no of a student
      f) Delete entries of particular student

   B) Create a set of RESTful endpoints using Node.js, Express, and Mongoose for handling student data operations.
   The endpoints should support:
   - Retrieve a list of all students.
   - Retrieve details of an individual student by ID.
   - Add a new student to the database.
   - Update details of an existing student by ID.
   - Delete a student from the database by ID.

   Connect the server to MongoDB using Mongoose, and store student data with attributes: name, age, and grade.

MongoDB and RESTful API Integration
Introduction

MongoDB is a popular NoSQL database that stores data in a flexible, document-oriented format called BSON (Binary JSON). Its schema-less nature makes it ideal for modern applications that deal with unstructured or semi-structured data. When paired with RESTful APIs, MongoDB provides a powerful mechanism for seamless communication between web applications and databases, leveraging standard HTTP methods for CRUD (Create, Read, Update, Delete) operations. This integration is particularly beneficial for web and mobile applications due to its efficiency and scalability.

RESTful Architecture with MongoDB

REST (Representational State Transfer) is an architectural style that enables stateless communication between clients and servers over HTTP. RESTful APIs use standard methods like GET, POST, PUT, PATCH, and DELETE to interact with resources. When integrated with MongoDB:

- Data is exchanged in JSON format, which aligns well with MongoDB's document model.
- REST endpoints provide a structured way to manipulate and retrieve data stored in MongoDB collections.

CRUD Operations in MongoDB Using RESTful Endpoints

Create Operation (POST Method)

The *Create* operation inserts new documents into a MongoDB collection. In a RESTful API:

- The **POST** method is used to send data to the server.
- Example endpoint:

bash
POST /api/products

This endpoint accepts JSON payloads containing product details and inserts them into the database.

Read Operation (GET Method)

The *Read* operation retrieves data from MongoDB collections. The **GET** method is used for fetching documents:

- Fetch all documents:

bash
GET /api/products

- Fetch a specific document by ID:

bash
GET /api/products/:id

Update Operation (PUT/PATCH Methods)

The *Update* operation modifies existing documents in the collection:

- **PUT** replaces the entire document.

bash
PUT /api/products/:id

- **PATCH** updates specific fields of a document.

bash
PATCH /api/products/:id

Delete Operation (DELETE Method)

The *Delete* operation removes documents from the collection using the **DELETE** method:

- Delete a specific document by ID:

bash

DELETE /api/products/:id

Advantages of Using MongoDB with RESTful APIs

1. **Flexibility:** MongoDB's schema-less design allows dynamic changes to data structure without migration.
2. **Scalability:** MongoDB supports horizontal scaling through sharding, making it suitable for large-scale applications.
3. **Ease of Integration:** JSON-based REST APIs align seamlessly with MongoDB's BSON format.
4. **Efficiency:** RESTful APIs simplify CRUD operations while maintaining statelessness.

Implementation Example

Using Node.js and Express.js as the backend framework:

1. Set up a connection to MongoDB using the MongoClient.
2. Define RESTful endpoints for CRUD operations.
3. Example code snippet for creating a product:

javascript

```
app.post("/api/products", (req, res) => {
   collection.insertOne(req.body, (err, result) => {
      if (err) return res.status(500).send(err);
      res.send(result);
   });
});
```

4. Test endpoints using tools like Postman or curl.

Output:

A)

```
> show dbs
< admin      40.00 KiB
  config     72.00 KiB
  inventory  72.00 KiB
  local      72.00 KiB
> use IT_Dept
< switched to db IT_Dept
> db.students.insertOne({
    name: "John Doe",
    roll_no: 101,
    class_name: "IT-A"
  })
< {
    acknowledged: true,
    insertedId: ObjectId('67db92f42caef4eeddce6aaa')
  }
```

```
> db.students.insertMany([
    { name: "Alice", roll_no: 102, class_name: "IT-A" },
    { name: "Bob", roll_no: 103, class_name: "IT-B" },
    { name: "Charlie", roll_no: 104, class_name: "IT-A" }
  ])
< {
    acknowledged: true,
    insertedIds: {
      '0': ObjectId('67db92fa2caef4eeddce6aab'),
      '1': ObjectId('67db92fa2caef4eeddce6aac'),
      '2': ObjectId('67db92fa2caef4eeddce6aad')
    }
  }
> db.students.find().pretty()
```

```
> db.students.find().pretty()
< {
    _id: ObjectId('67db92f42caef4eeddce6aaa'),
    name: 'John Doe',
    roll_no: 101,
    class_name: 'IT-A'
  }
  {
    _id: ObjectId('67db92fa2caef4eeddce6aab'),
    name: 'Alice',
    roll_no: 102,
    class_name: 'IT-A'
  }
  {
    _id: ObjectId('67db92fa2caef4eeddce6aac'),
    name: 'Bob',
    roll_no: 103,
    class_name: 'IT-B'
  }
  {
    _id: ObjectId('67db92fa2caef4eeddce6aad'),
    name: 'Charlie',
    roll_no: 104,
    class_name: 'IT-A'
```

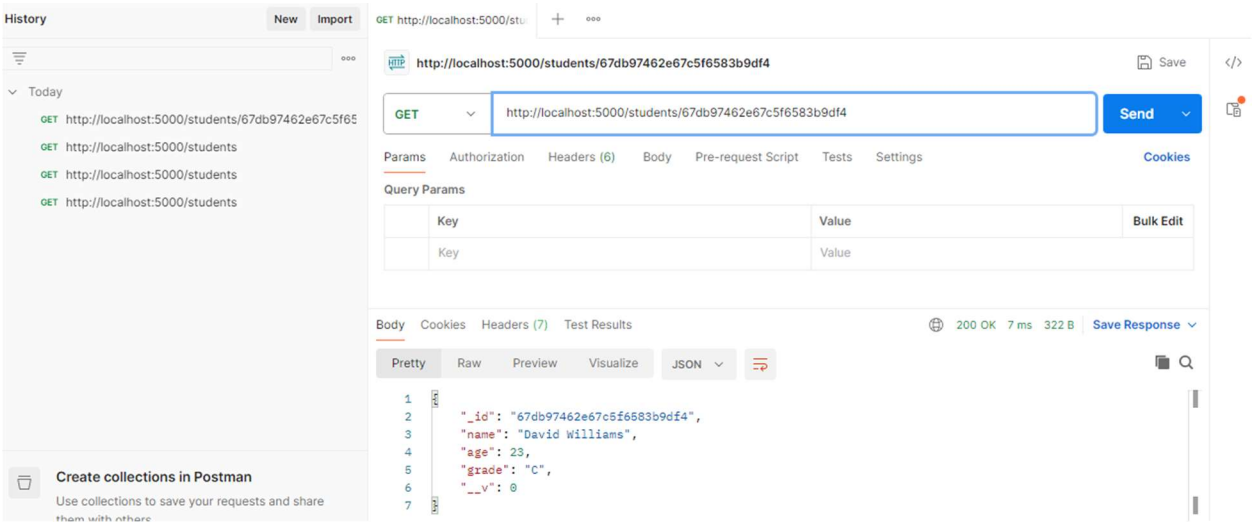
```
> db.students.find({ class_name: "IT-A" })
< {
    _id: ObjectId('67db92f42caef4eeddce6aaa'),
    name: 'John Doe',
    roll_no: 101,
    class_name: 'IT-A'
  }
  {
    _id: ObjectId('67db92fa2caef4eeddce6aab'),
    name: 'Alice',
    roll_no: 102,
    class_name: 'IT-A'
  }
  {
    _id: ObjectId('67db92fa2caef4eeddce6aad'),
    name: 'Charlie',
    roll_no: 104,
    class_name: 'IT-A'
  }
> db.students.find({ roll_no: 102, class_name: "IT-A" })
< {
    _id: ObjectId('67db92fa2caef4eeddce6aab'),
    name: 'Alice',
    roll_no: 102,
```

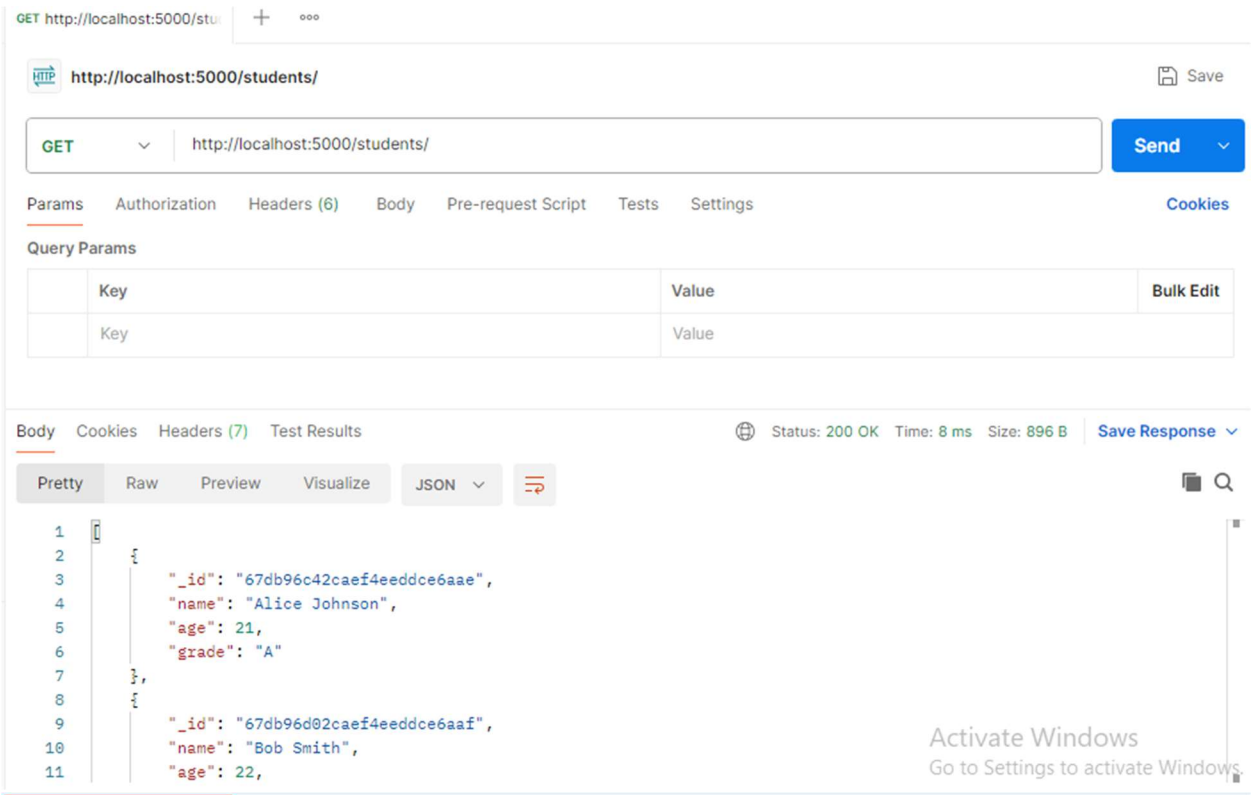
```
> db.students.find({ roll_no: 102, class_name: "IT-A" })
< {
    _id: ObjectId('67db92fa2caef4eeddce6aab'),
    name: 'Alice',
    roll_no: 102,
    class_name: 'IT-A'
  }
> db.students.updateOne(
     { name: "John Doe" },  # Find condition
     { $set: { roll_no: 110 } }  # Update action
  )
```

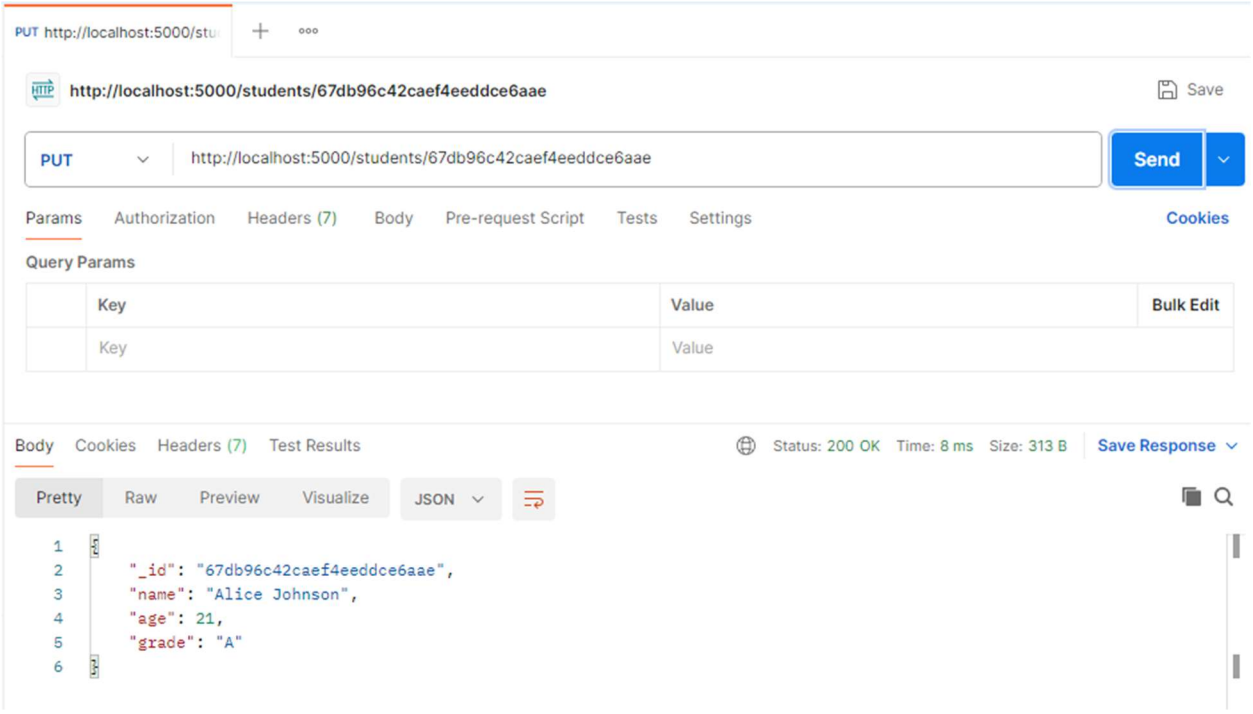
```
> db.students.updateMany(
     { class_name: "IT-A" },
     { $set: { class_name: "IT-C" } }
  )
< {
    acknowledged: true,
    insertedId: null,
    matchedCount: 3,
    modifiedCount: 3,
    upsertedCount: 0
  }
> db.students.deleteOne({ name: "John Doe" })
< {
    acknowledged: true,
    deletedCount: 1
  }
> db.students.deleteMany({ class_name: "IT-A" })
< {
    acknowledged: true,
    deletedCount: 0
  }
```

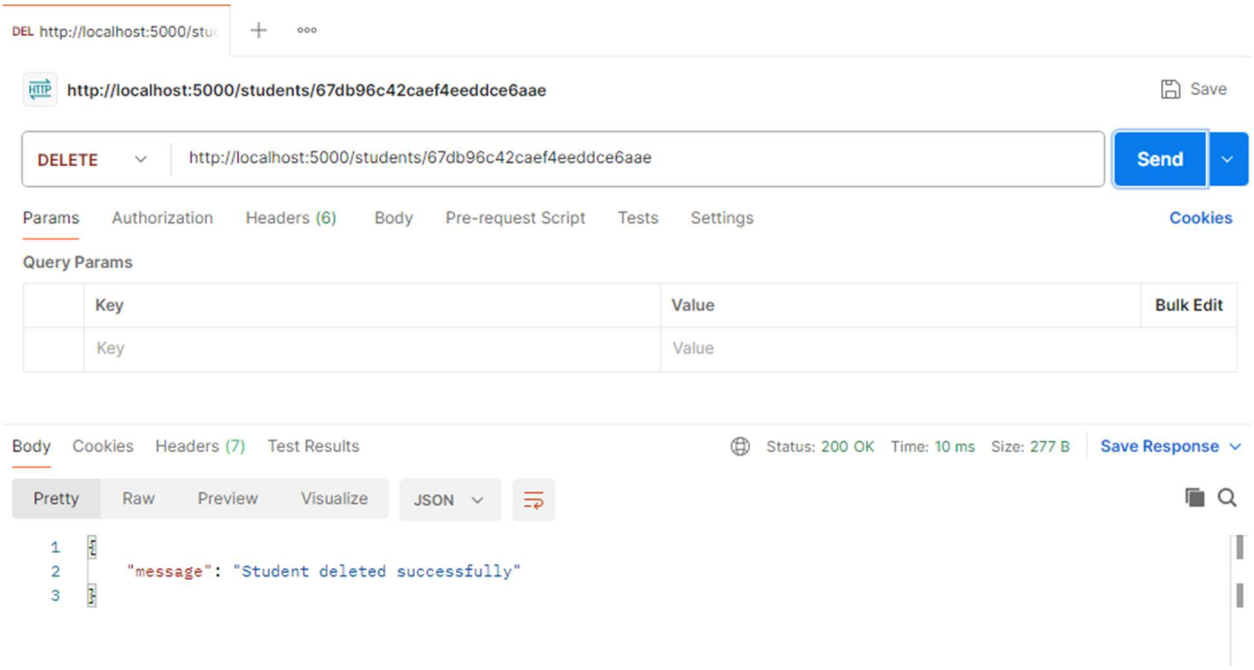
```
> show collections
< students
> db.students.drop()
< true
IT_Dept>
```

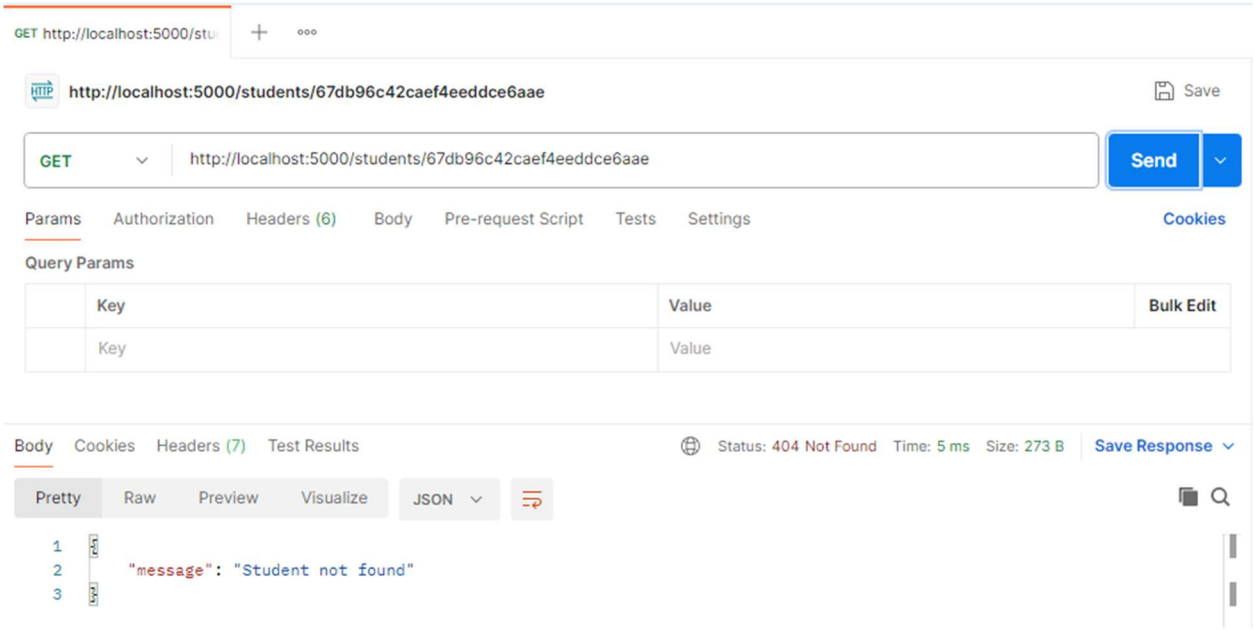
B)

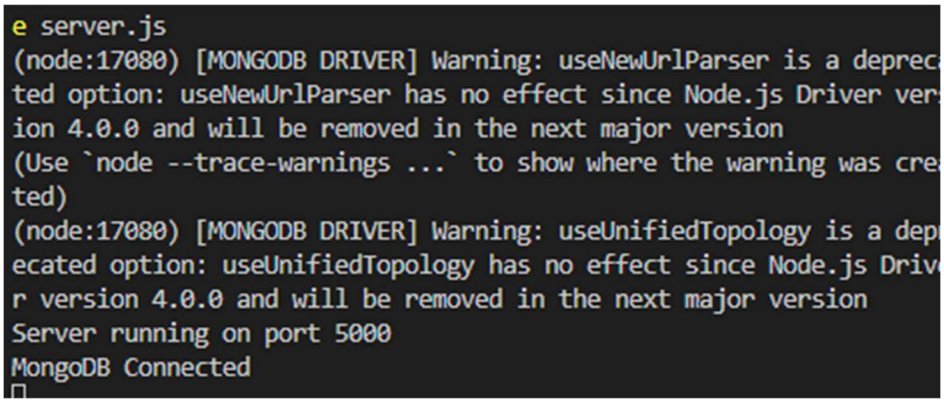



GET http://localhost:5000/stu
http://localhost:5000/students/
Save
GET
http://localhost:5000/students/
Send
Params
Authorization
Headers (6)
Body
Pre-request Script
Tests
Settings
Cookies
Query Params
Key
Value
Bulk Edit
Key
Value
Body
Cookies
Headers (7)
Test Results
Status: 200 OK
Time: 8 ms
Size: 896 B
Save Response
Pretty
Raw
Preview
Visualize
JSON
1 [
2 {
3 "_id": "67db96c42caef4eeddce6aae",
4 "name": "Alice Johnson",
5 "age": 21,
6 "grade": "A"
7 },
8 {
9 "_id": "67db96d02caef4eeddce6aaf",
10 "name": "Bob Smith",
11 "age": 22,
Activate Windows
Go to Settings to activate Windows.


PUT http://localhost:5000/stu
http://localhost:5000/students/67db96c42caef4eeddce6aae
Save
PUT
http://localhost:5000/students/67db96c42caef4eeddce6aae
Send
Params
Authorization
Headers (7)
Body
Pre-request Script
Tests
Settings
Cookies
Query Params
Key
Value
Bulk Edit
Key
Value
Body
Cookies
Headers (7)
Test Results
Status: 200 OK
Time: 8 ms
Size: 313 B
Save Response
Pretty
Raw
Preview
Visualize
JSON
1 {
2 "_id": "67db96c42caef4eeddce6aae",
3 "name": "Alice Johnson",
4 "age": 21,
5 "grade": "A"
6 }


DEL http://localhost:5000/stu
http://localhost:5000/students/67db96c42caef4eeddce6aae
Save
DELETE
http://localhost:5000/students/67db96c42caef4eeddce6aae
Send
Params
Authorization
Headers (6)
Body
Pre-request Script
Tests
Settings
Cookies
Query Params
Key
Value
Bulk Edit
Key
Value
Body
Cookies
Headers (7)
Test Results
Status: 200 OK
Time: 10 ms
Size: 277 B
Save Response
Pretty
Raw
Preview
Visualize
JSON
1
2
3
"message": "Student deleted successfully"


GET http://localhost:5000/stu
http://localhost:5000/students/67db96c42caef4eeddce6aae
Save
GET
http://localhost:5000/students/67db96c42caef4eeddce6aae
Send
Params
Authorization
Headers (6)
Body
Pre-request Script
Tests
Settings
Cookies
Query Params
Key
Value
Bulk Edit
Key
Value
Body
Cookies
Headers (7)
Test Results
Status: 404 Not Found
Time: 5 ms
Size: 273 B
Save Response
Pretty
Raw
Preview
Visualize
JSON
1
2
3
"message": "Student not found"


e server.js
(node:17080) [MONGODB DRIVER] Warning: useNewUrlParser is a deprec
ted option: useNewUrlParser has no effect since Node.js Driver ver
ion 4.0.0 and will be removed in the next major version
(Use `node --trace-warnings ...` to show where the warning was cre
ted)
(node:17080) [MONGODB DRIVER] Warning: useUnifiedTopology is a dep
ecated option: useUnifiedTopology has no effect since Node.js Driv
r version 4.0.0 and will be removed in the next major version
Server running on port 5000
MongoDB Connected

Add student

```
const mongoose = require("mongoose");
const Student = require("./models/Student"); // Import the model

// Connect to MongoDB
mongoose
  .connect("mongodb://127.0.0.1:27017/studentDB", { useNewUrlParser: true,
useUnifiedTopology: true })
  .then(() => console.log("MongoDB Connected"))
  .catch(err => console.error(err));

// Sample Student Data
const students = [
  { name: "Alice Johnson", age: 21, grade: "A" },
  { name: "Bob Smith", age: 22, grade: "B" },
  { name: "Charlie Brown", age: 20, grade: "A" },
  { name: "David Williams", age: 23, grade: "C" }
];

// Insert Data
Student.insertMany(students)
  .then(() => {
    console.log("Students Added!");
    mongoose.connection.close();
  })
  .catch(err => console.error(err));
```

```
PS C:\Users\Student\web\student-api> node addStudents.js
>>
(node:17960) [MONGODB DRIVER] Warning: useNewUrlParser is a deprec
ted option: useNewUrlParser has no effect since Node.js Driver ver
ion 4.0.0 and will be removed in the next major version
(Use `node --trace-warnings ...` to show where the warning was cre
ted)
(node:17960) [MONGODB DRIVER] Warning: useUnifiedTopology is a dep
ecated option: useUnifiedTopology has no effect since Node.js Driv
r version 4.0.0 and will be removed in the next major version
MongoDB Connected
Students Added!
```


Model

```
const mongoose = require("mongoose");

const StudentSchema = new mongoose.Schema({
  name: { type: String, required: true },
  age: { type: Number, required: true },
  grade: { type: String, required: true }
});

module.exports = mongoose.model("Student", StudentSchema);
```

Routes

```
const express = require("express");
const router = express.Router();
const Student = require("../models/Student");

// 📌 1. Get all students
router.get("/", async (req, res) => {
  try {
    const students = await Student.find();
    res.json(students);
  } catch (err) {
    res.status(500).json({ message: err.message });
  }
});

// 📌 2. Get student by ID
router.get("/:id", async (req, res) => {
  try {
    const student = await Student.findById(req.params.id);
    if (!student) return res.status(404).json({ message: "Student not
found" });
    res.json(student);
  } catch (err) {
    res.status(500).json({ message: err.message });
  }
});

// 📌 3. Add a new student
router.post("/", async (req, res) => {
```

```
  const { name, age, grade } = req.body;
  const student = new Student({ name, age, grade });

  try {
    const newStudent = await student.save();
    res.status(201).json(newStudent);
  } catch (err) {
    res.status(400).json({ message: err.message });
  }
});

// 📌 4. Update student by ID
router.put("/:id", async (req, res) => {
  try {
    const updatedStudent = await Student.findByIdAndUpdate(req.params.id,
req.body, { new: true });
    if (!updatedStudent) return res.status(404).json({ message: "Student
not found" });
    res.json(updatedStudent);
  } catch (err) {
    res.status(400).json({ message: err.message });
  }
});

// 📌 5. Delete student by ID
router.delete("/:id", async (req, res) => {
  try {
    const deletedStudent = await Student.findByIdAndDelete(req.params.id);
    if (!deletedStudent) return res.status(404).json({ message: "Student
not found" });
    res.json({ message: "Student deleted successfully" });
  } catch (err) {
    res.status(500).json({ message: err.message });
  }
});

module.exports = router;
```

Server

```
require("dotenv").config();
const express = require("express");
const mongoose = require("mongoose");
const bodyParser = require("body-parser");
const studentRoutes = require("./routes/studentRoutes");

const app = express();
const PORT = process.env.PORT || 5000;

// Middleware
app.use(bodyParser.json());
app.use("/students", studentRoutes);

// MongoDB Connection
mongoose
  .connect(process.env.MONGO_URI, { useNewUrlParser: true,
useUnifiedTopology: true })
  .then(() => console.log("MongoDB Connected"))
  .catch(err => console.error(err));

app.listen(PORT, () => console.log(`Server running on port ${PORT}`));
```

Conclusion

Integrating MongoDB with RESTful APIs provides developers with an efficient and scalable solution for managing application data. By leveraging HTTP methods and JSON-based communication, developers can build robust web applications capable of handling diverse data structures and high traffic loads.