

Practical No. 8 Study and implementation of node.js

<https://github.com/themonstersd13/WddlExp8>

Problem Statement 1: Introduction to Node.js

1. What is Node.js, and how does it differ from traditional server-side platforms like Apache or PHP?

Node.js is an asynchronous, event-driven JavaScript runtime designed for building scalable network applications [Node.js — Run JavaScript Everywhere](#). It differs from platforms like Apache or PHP—which use a thread-per-request and blocking I/O model—by employing a single-threaded, non-blocking architecture that can handle many concurrent connections within one process [zibtek.comNode.js — Run JavaScript Everywhere](#).

2. What is the purpose of the V8 engine in Node.js?

Node.js uses Google's V8 engine to compile JavaScript into machine code at runtime, providing high-performance execution outside of the browser [GeeksforGeeks](#). V8 is integral to Node.js and cannot be replaced, as it underlies all server-side JavaScript execution [GeeksforGeeks](#).

3. Explain the single-threaded, event-driven architecture of Node.js.

Node.js executes JavaScript on a single main thread via an event loop that delegates I/O operations to the system kernel or an internal thread pool and invokes callbacks when those operations complete [Medium](#).

4. Why is Node.js considered non-blocking?

All I/O operations in Node.js are non-blocking: when an operation starts, Node.js registers a callback and immediately continues processing other events, running the callback only after the operation finishes [Node.js — Run JavaScript Everywhere](#).

5. What is npm, and how is it used in Node.js?

npm is the default package manager for Node.js, used to install, update, and manage dependencies from the npm registry via commands like `npm install package-name` [Node.js — Run JavaScript Everywhere](#). It hosts over two million packages, making it the largest code repository of its kind [Node.js — Run JavaScript Everywhere](#).

6. What is a module in Node.js? How do you export and import modules?

In Node.js, a module is any file or directory that encapsulates code. Developers export functionality using `module.exports` or `exports.foo` in CommonJS or `export` in ES Modules, and they import modules via `require('./module')` or `import` statements [SitePoint](#). Modules are defined as files exposing public APIs and are consumed by other files via these mechanisms [npm Docs](#).

7. What is the difference between require() and import in Node.js?

`require()` is the CommonJS loader that synchronously loads modules based on `module.exports`, while `import/export` are the ECMAScript Module syntax, which supports static analysis and may be asynchronous; using `import` requires setting `"type": "module"` in `package.json` or using the `.mjs` extension [Medium](#).

8. How can you create a custom module in Node.js?

Create a file (e.g., `greet.js`) and assign your functionality to `module.exports`, for example:

```
function greet(name) {  
  return Hello, ${name}!;  
}
```

```
module.exports = greet
```

Then load it elsewhere with:

```
const greet = require('./greet')  
console.log(greet('Alice')) npm Docs.
```

9. What is the role of the package.json file in a Node.js project?

The `package.json` file defines project metadata (name, version, description), lists `dependencies` and `devDependencies`, and declares `scripts` (such as `"start"` and `"test"`), guiding npm on how to install and run the project [npm Docs](#).

10. How do you install a package globally and locally using npm?

To install locally (for a project), run `npm install package-name`, which adds it to `node_modules` and updates `package.json`. To install globally (system-wide executables), run `npm install -g package-name` [Medium](#) [npm Docs](#).

11. What is the difference between asynchronous and synchronous programming in Node.js?

Synchronous functions block the event loop until they complete, whereas

asynchronous functions initiate operations and return immediately, allowing the event loop to continue processing other tasks and invoking callbacks upon completion [Stack OverflowGeeksforGeeks](#).

12. How do you create an HTTP server in Node.js?

Use the built-in `http` module:

```
const http = require('http')
const server = http.createServer((req, res) => {
  res.writeHead(200, {'Content-Type': 'text/plain'})
  res.end('Hello World')
})
server.listen(3000) Node.js — Run JavaScript Everywhere.
```

13. What is the difference between `http.createServer()` and using frameworks like Express.js?

`http.createServer()` provides a minimal, low-level HTTP server requiring manual routing and parsing of requests, whereas Express.js builds on it to offer declarative routing, middleware support, built-in body parsing, and many utilities out of the box [The freeCodeCamp Forum](#).

14. How do you handle GET and POST requests in Node.js?

In a raw HTTP server, check `req.method === 'GET'` and `req.url` to handle GET. For POST, check `req.method === 'POST'`, listen for `req.on('data', chunk)` to collect body data, concatenate the chunks, then process in `req.on('end')` before sending a response

Problem Statement 2: Middleware (Express.js)

1.What Is Middleware in Node.js / Express.js?

Middleware functions are functions that have access to the request object (`req`), the response object (`res`), and the next middleware function in the application's request–response cycle [Express](#).

They can execute any code, make changes to `req` and `res`, end the request–response cycle, or call `next()` to pass control to the next matching middleware [Express](#).

2.How to Create Custom Middleware in Express.js

A custom middleware is simply a function defined with three parameters: (`req`, `res`, `next`) [DigitalOcean](#).

Within the function you can inspect or modify `req` and `res`, then either end the cycle (e.g., `res.send()`) or call `next()` to hand off control [DigitalOcean](#).

Example (`logger.js`):

```
// logger.js
module.exports = function logger(req, res, next) {
  console.log(`${req.method} ${req.url}`);
  next();
};
```

Register it in your app with `app.use()` (application-level) or `router.use()` (router-level) [GeeksforGeeks](#).

3.Execution Order of Middleware in Express.js

Express evaluates middleware and routes in the order they are registered with `app.use()`, `app.METHOD()`, or `router.use()`, so placement in your code determines the execution sequence [Stack Overflow](#).

Once a middleware calls `next()`, control moves to the very next matching middleware; if it sends a response without calling `next()`, no subsequent handlers run [Stack Overflow](#).

before more specific ones (e.g., `app.use('/api', ...)`) can preempt them, since `/:id` will match `/api` first [Reddit](#).

Problem Statement 3: File System (fs) Module

1. How do you read and write files using the fs module in Node.js?

Asynchronous reading:

Use `fs.readFile(path, [encoding], callback)` to read a file without blocking. The callback receives `(err, data)`, where `data` is a `Buffer` or string.

[Node.js — Run JavaScript Everywhere](#)

```
const fs = require('fs');
fs.readFile('example.txt', 'utf8', (err, data) => {
  if (err) throw err;
  console.log(data);
});
```

Asynchronous writing:

Use `fs.writeFile(path, data[, options], callback)` to write data to a file. If the file does not exist, it is created. [Node.js — Run JavaScript Everywhere](#)

```
const fs = require('fs');
const content = 'Hello, World!';
fs.writeFile('output.txt', content, err => {
  if (err) throw err;
  console.log('File written successfully');
});
```

- Synchronous methods:
The module also offers `fs.readFileSync(path, [encoding])` and `fs.writeFileSync(path, data[, options])`, which return results directly but block the event loop until finished. [Stack Overflow](#)

2. What is the difference between `fs.readFile()` and `fs.readFileSync()`?

- `fs.readFile()` is asynchronous: it issues the I/O operation, registers a callback, and immediately returns control to the event loop; the callback is

invoked when data is ready. [Stack Overflow](#)

- `fs.readFileSync()` is synchronous: it reads and returns the file's contents before moving to the next line of code, blocking the entire thread until the read completes. [Stack Overflow](#)

3.How can you check if a file or directory exists in Node.js?

- Deprecated: `fs.exists(path, callback)` and `fs.existsSync(path)` exist but are discouraged due to race-condition issues. [Node.js — Run JavaScript Everywhere](#)
- Recommended:
 - `fs.access(path, fs.constants.F_OK, callback)` to asynchronously check existence/permissions. [Node.js — Run JavaScript Everywhere](#)
 - `fs.stat(path, callback)` to retrieve stats (and detect “not found” errors).

```
const fs = require('fs');
fs.access('myfile.txt', fs.constants.F_OK, err => {
  console.log(err ? 'Not found' : 'Exists');
});
```

4.How do you handle file operations in an asynchronous manner?

- Callbacks: Pass a callback to the async API; errors are handled inside the callback.

Promises: Use the `fs.promises` API or wrap callback methods with `util.promisify()`. [Stack Overflow](#)

```
const fs = require('fs').promises;
async function load() {
  try {
```

```
    const data = await fs.readFile('example.txt', 'utf8');  
    console.log(data);  
  } catch (err) {  
    console.error(err);  
  }  
}  
load();
```

- Streams: For large files, use `fs.createReadStream()` and `fs.createWriteStream()` to process data in chunks without loading the entire file into memory. [Honeybadger](#)
- Error handling: Always handle errors either via callback checks, `.catch()`, or `try/catch` in async functions.

Problem Statement 4: Database Connectivity

Q1: How do you connect to a SQL or Oracle database from a Node.js application?

A:

To connect to a SQL or Oracle database from a Node.js application, you can use specific libraries:

- MySQL: Use the `mysql2` library.

Install: `npm install mysql2`

Example:

```
const mysql = require('mysql2');
const connection = mysql.createConnection({
  host: 'localhost',
  user: 'your_username',
  password: 'your_password',
  database: 'your_database'
});

connection.connect((err) => {
  if (err) throw err;
  console.log('Connected to MySQL database.');
```

- Oracle: Use the `oracledb` library.

Install: `npm install oracledb`

Example:

```
const oracledb = require('oracledb');
```



```
async function connect() {
  try {
    const connection = await oracledb.getConnection({
      user: 'your_username',
      password: 'your_password',
      connectString: 'localhost/XEPDB1'
    });
    console.log('Connected to Oracle database.');
```

```
    await connection.close();
  } catch (err) {
    console.error(err);
  }
}

connect();
```

Q2: What is the purpose of the `mysql2` library in Node.js?

A:

The `mysql2` library is a Node.js driver for MySQL that provides:

- Improved performance over the older `mysql` library.
 - Support for Promises and `async/await` syntax.
 - Prepared statements to prevent SQL injection.
 - Connection pooling for efficient resource management.
-

Q3: How would you perform basic CRUD operations (Create, Read, Update, Delete) using MySQL and Node.js?

A:

Using the `mysql2` library:

Create (INSERT):

```
connection.query(
  'INSERT INTO users (name, email) VALUES (?, ?)',
  ['John Doe', 'john@example.com'],
  (err, results) => {
    if (err) throw err;
    console.log('User added:', results.insertId);
  }
);
```

Read (SELECT):

```
connection.query(
  'SELECT * FROM users WHERE id = ?',
  [1],
  (err, results) => {
    if (err) throw err;
    console.log('User details:', results);
  }
);
```

Update (UPDATE):

```
connection.query(
  'UPDATE users SET email = ? WHERE id = ?',
  ['newemail@example.com', 1],
  (err, results) => {
    if (err) throw err;
    console.log('User updated:', results.affectedRows);
  }
);
```

Delete (DELETE):

```
connection.query(  
  'DELETE FROM users WHERE id = ?',  
  [1],  
  (err, results) => {  
    if (err) throw err;  
    console.log('User deleted:', results.affectedRows);  
  }  
);
```

Problem Statement 5: Building a RESTful API

Library & File Manager Test UI

Authentication

Register

Username

Password

Register

Login

Username

Password

Login

Books

Add New Book

Title

Author

Genre

Year

Add Book

Fetch Books

1

10

Genre filter

Author filter

Fetch

Library & File Manager Test UI

Authentication

Register

saurabhsd

Register

Registered & logged in

Login

Username

Password

Login

Books

Add New Book

Title

Author

Genre

Year

Add Book

Fetch Books

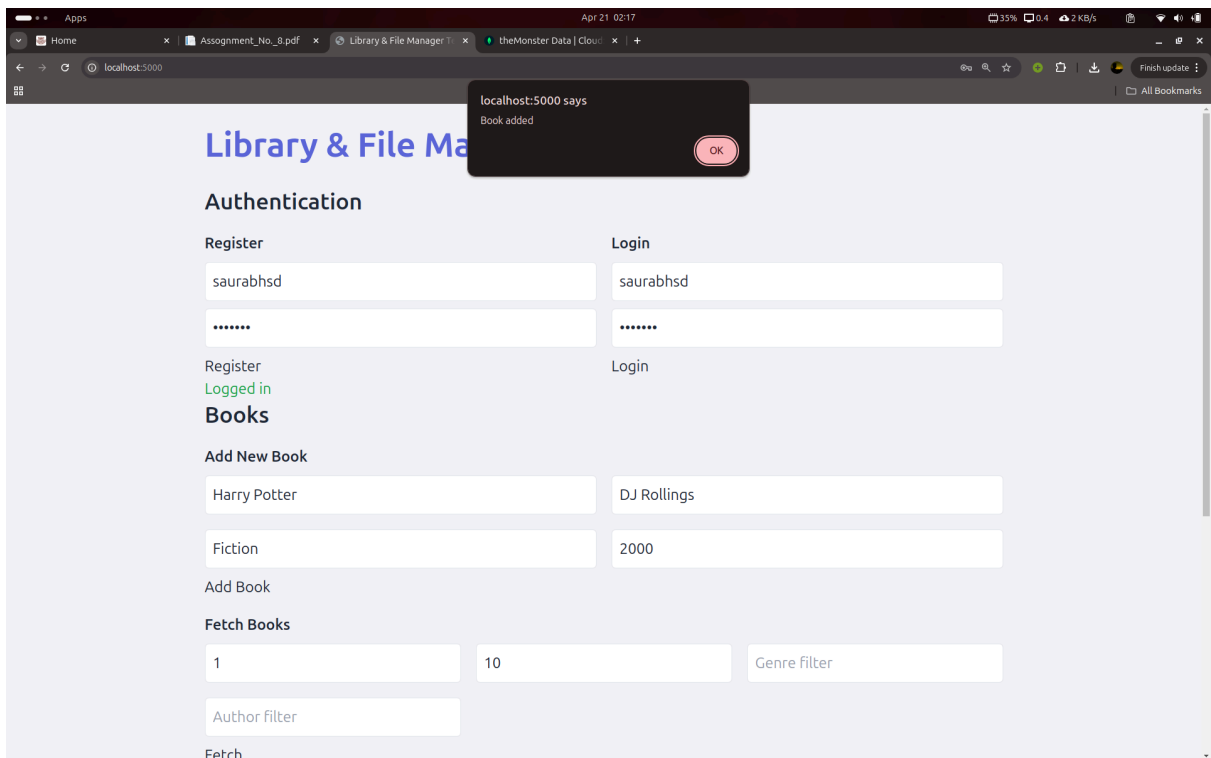
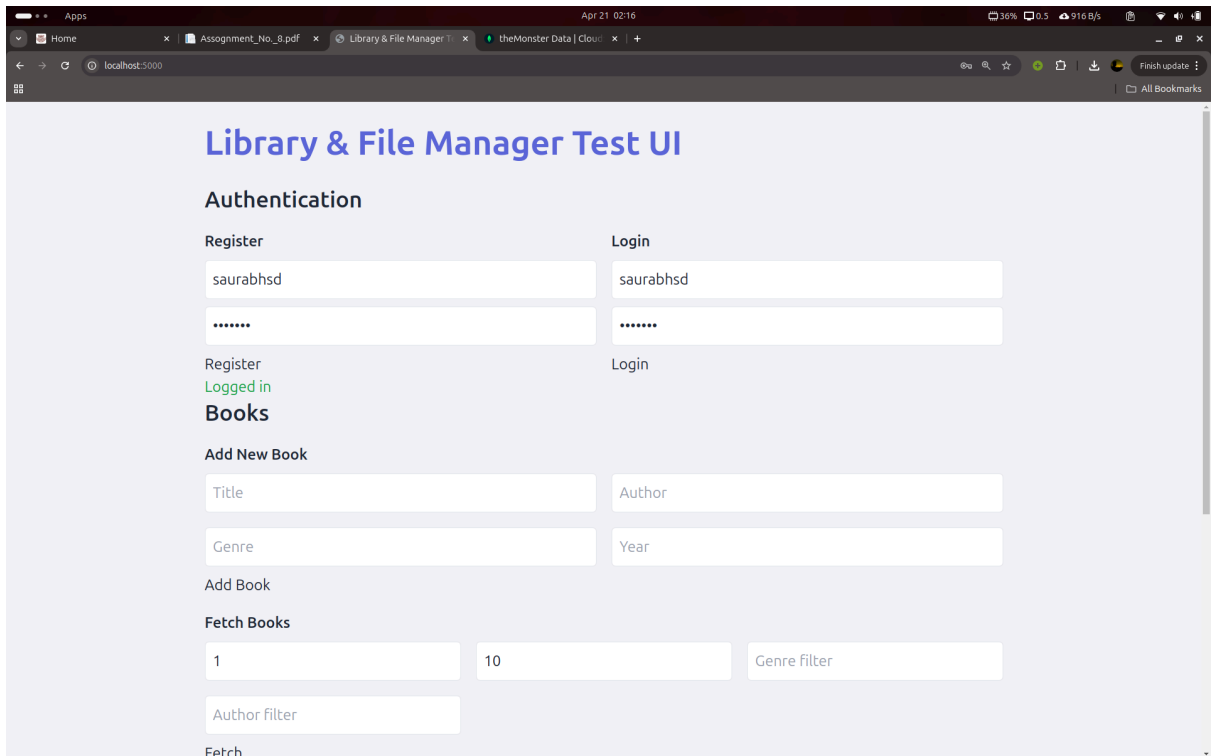
1

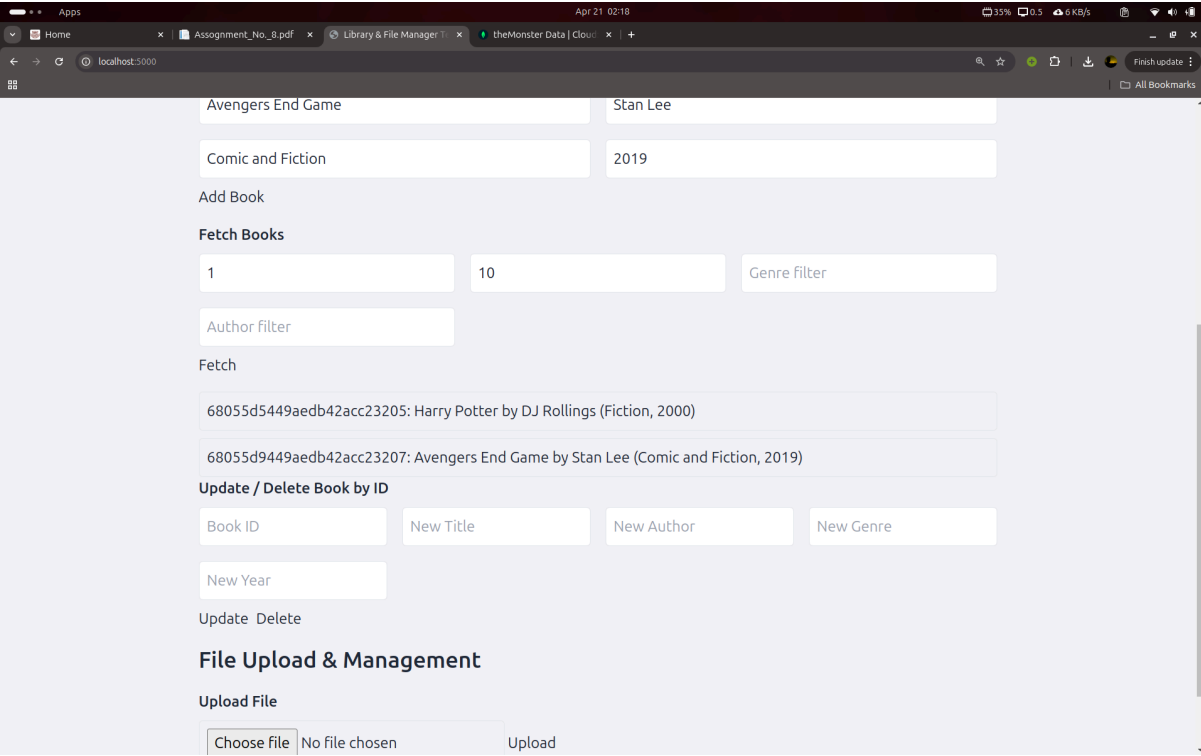
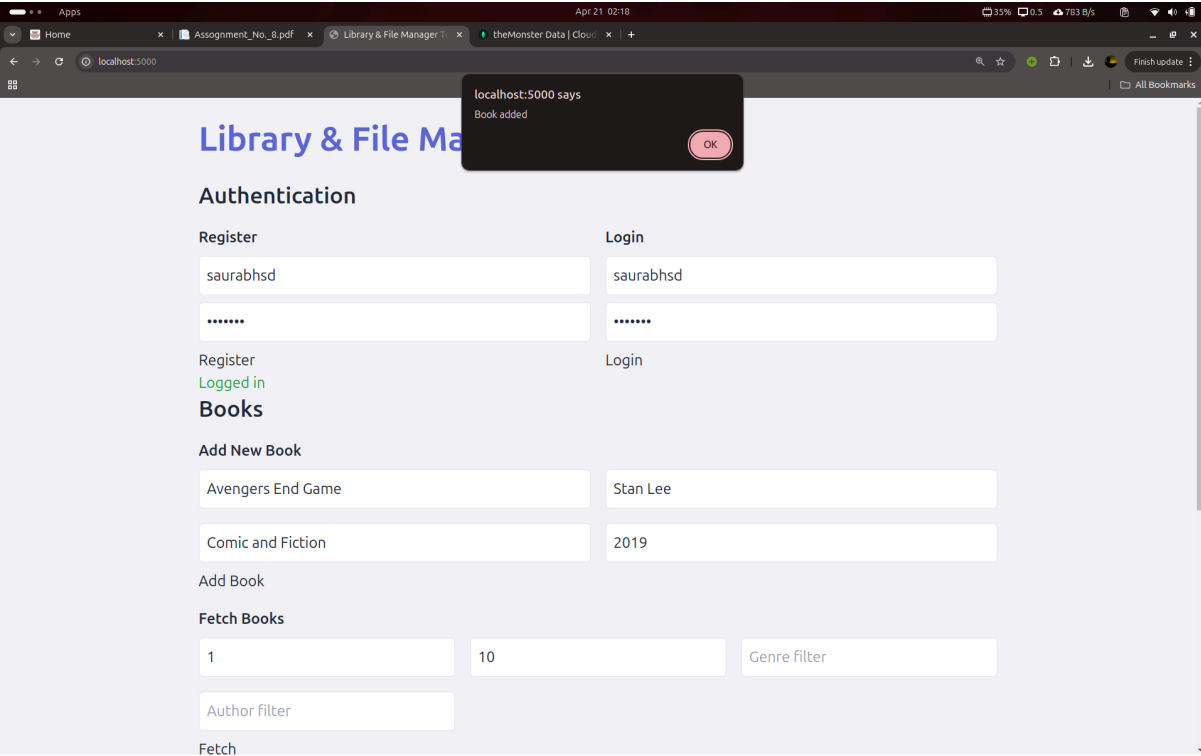
10

Genre filter

Author filter

Fetch





Apps

Apr 21, 02:19

14% 0.3 KB/s

Home

Assignment_No_8.pdf

Library & File Manager 1

theMonster Data | Cloud

localhost:5000

Finish update

All Bookmarks

Comic and Fiction

2019

Add Book

Fetch Books

1

10

Fiction

Author filter

Fetch

68055d5449aedb42acc23205: Harry Potter by DJ Rollings (Fiction, 2000)

Update / Delete Book by ID

Book ID

New Title

New Author

New Genre

New Year

Update Delete

File Upload & Management

Upload File

Choose file

No file chosen

Upload

Refresh File List

Apps

Apr 21, 02:19

15% 719 B/s

Home

Assignment_No_8.pdf

Library & File Manager 1

theMonster Data | Cloud

localhost:5000

Finish update

All Bookmarks

Avengers End Game

Stan Lee

Comic and Fiction

2019

Add Book

Fetch Books

1

10

Genre filter

Stan Lee

Fetch

68055d9449aedb42acc23207: Avengers End Game by Stan Lee (Comic and Fiction, 2019)

Update / Delete Book by ID

Book ID

New Title

New Author

New Genre

New Year

Update Delete

File Upload & Management

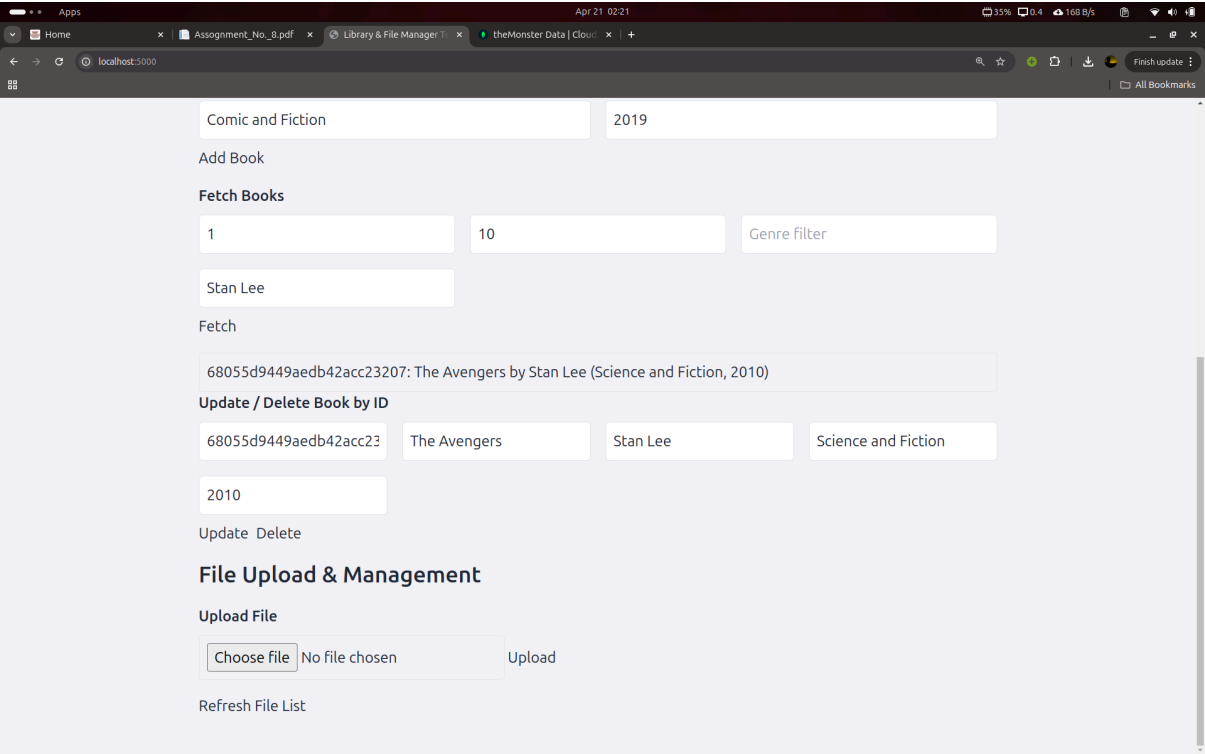
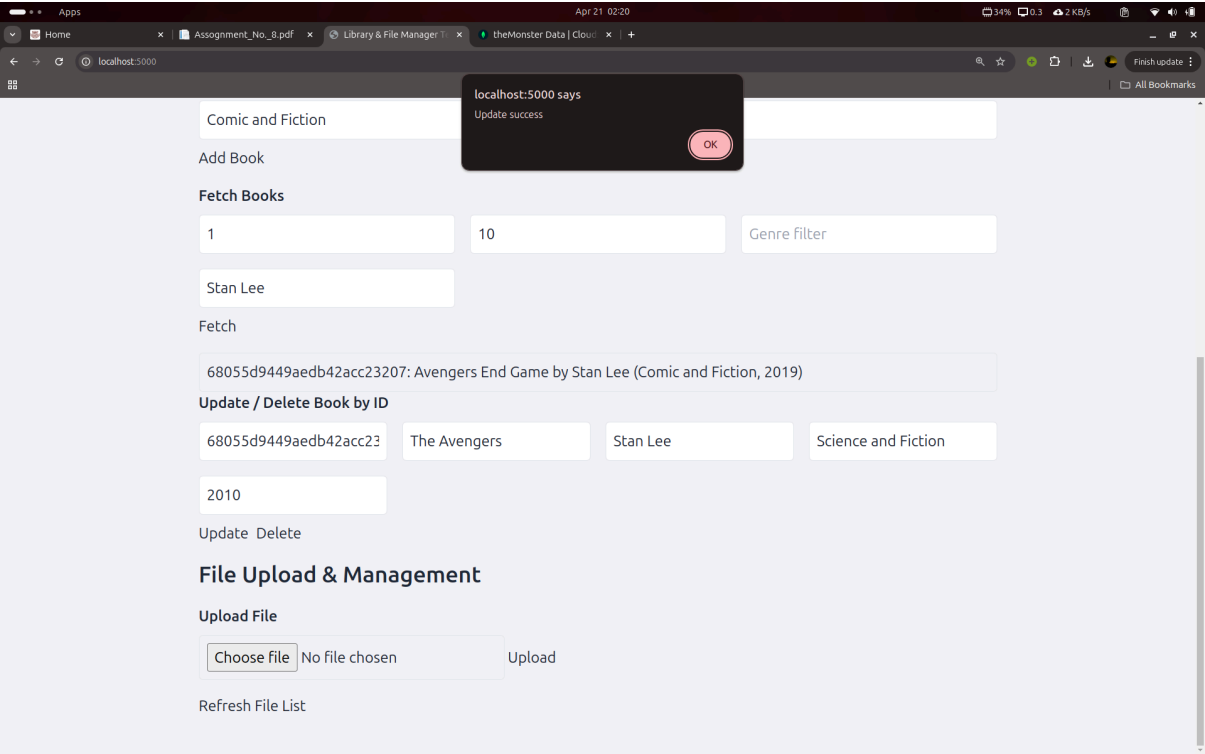
Upload File

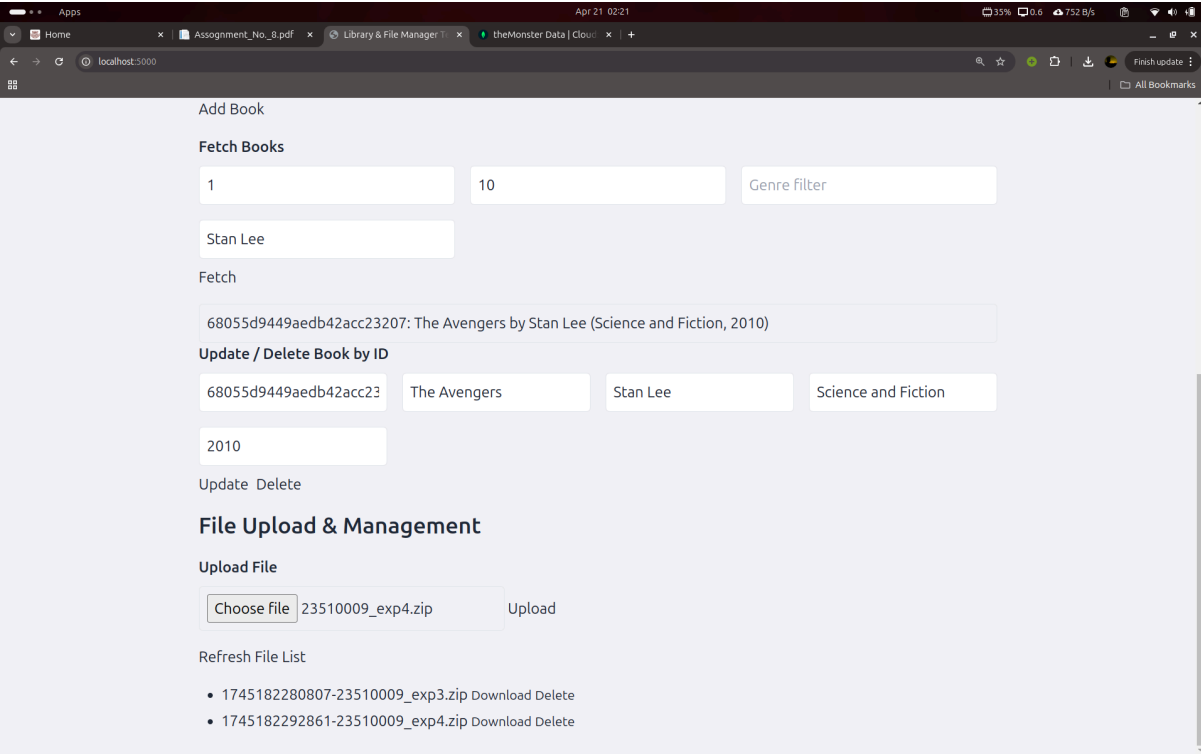
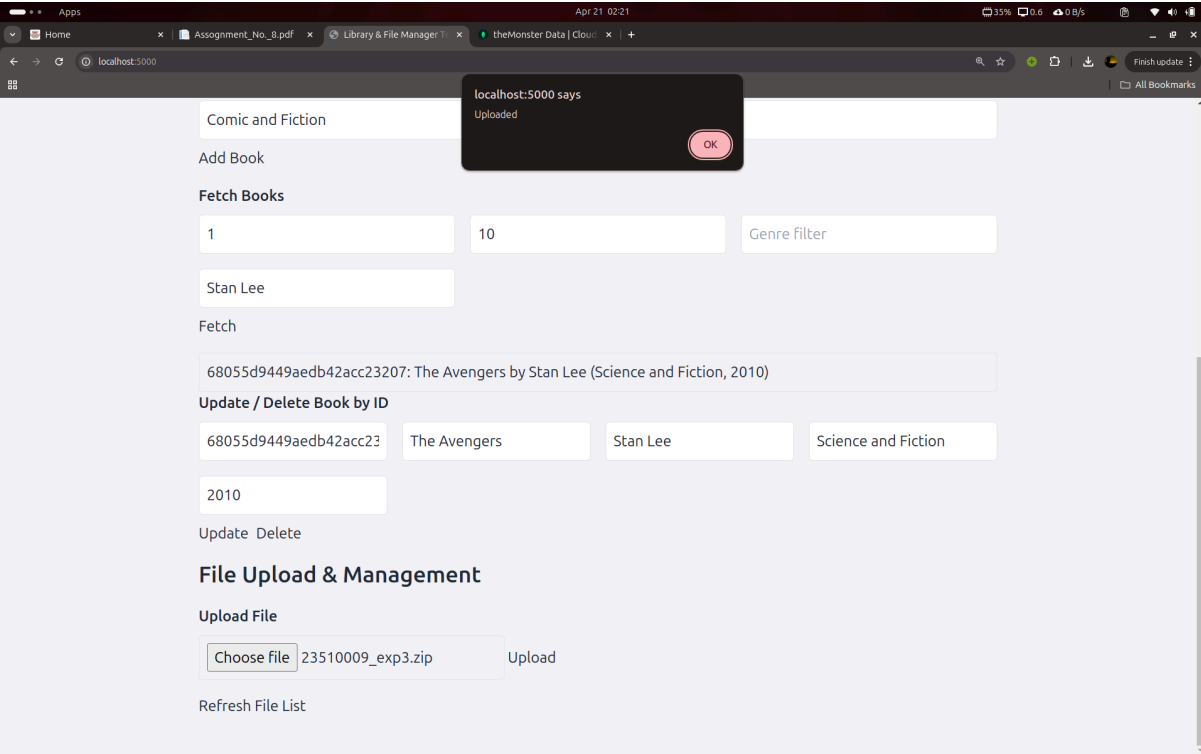
Choose file

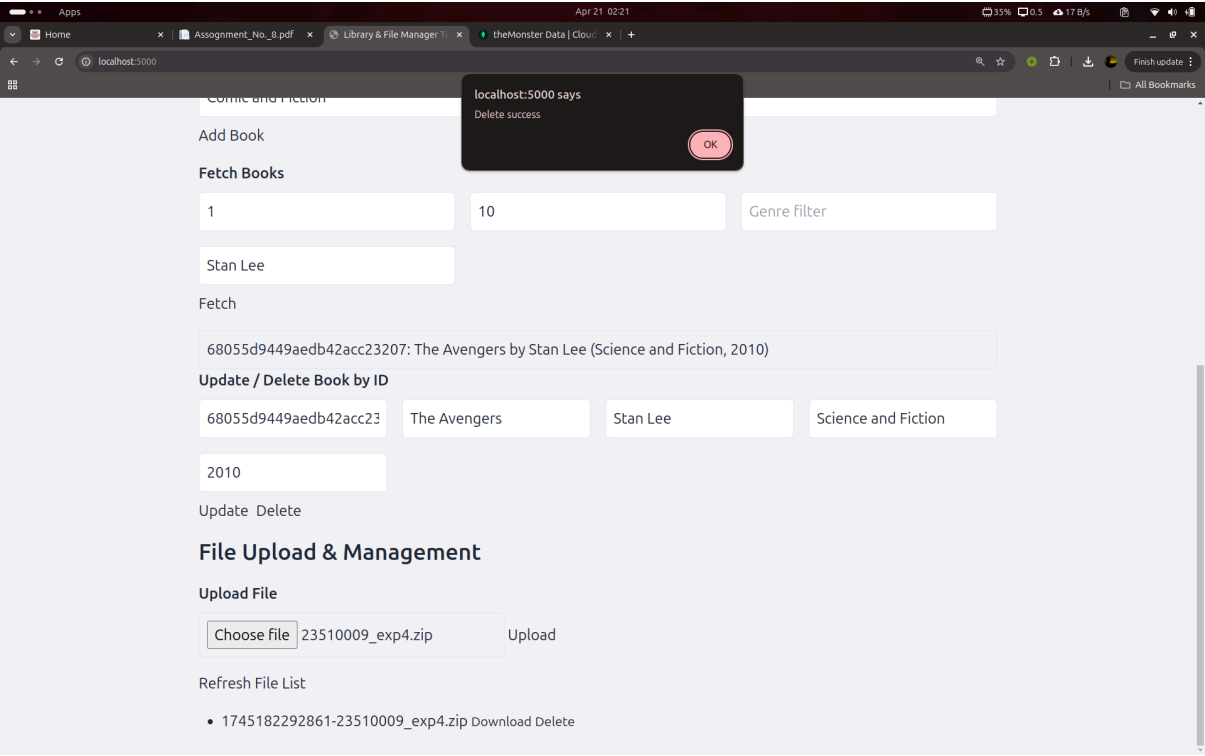
No file chosen

Upload

Refresh File List







Cluster Overview

ORGANIZATION: SAURABH's Org - 202... PROJECT: openSourceWce CLUSTER: theMonster

DATABASES: 2 COLLECTIONS: 9

+ Create Database

Search Namespaces

crop-care

test

DomainData

acses

books

domaindatas

leaderboard

users

test.books

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 30KB TOTAL DOCUMENTS: 2 INDEXES TOTAL SIZE: 36KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

INSERT DOCUMENT

Filter Type a query: { field: 'value' } Reset Apply Options

QUERY RESULTS: 1-2 OF 2

```
{
  "_id": ObjectId('68955d5449aedb42acc23285'),
  "title": "Harry Potter",
  "author": "DJ Rollings",
  "genre": "Fiction",
  "year": 2000,
  "createdAt": 2025-04-20T20:47:16.434+00:00,
  "updatedAt": 2025-04-20T20:47:16.434+00:00,
  "__v": 0
}
```

```
{
  "_id": ObjectId('68955d5449aedb42acc23287'),
  "title": "The Avengers",
  "author": "Stan Lee",
  "genre": "Science and Fiction",
  "year": 2010,
  "createdAt": 2025-04-20T20:48:26.493+00:00,
  "updatedAt": 2025-04-20T20:50:43.817+00:00,
  "__v": 0
}
```

System Status: All Good

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Cluster Overview

ORGANIZATION: SAURABH's Org - 202... PROJECT: openSourceWce CLUSTER: theMonster

DATABASES: 2 COLLECTIONS: 9

+ Create Database

Search Namespaces

crop-care

test

DomainData

acses

books

domaindatas

leaderboard

users

test.users

STORAGE SIZE: 36KB LOGICAL DATA SIZE: 4KB TOTAL DOCUMENTS: 14 INDEXES TOTAL SIZE: 72KB

Find Indexes Schema Anti-Patterns Aggregation Search Indexes

Generate queries from natural language in Compass

INSERT DOCUMENT

Filter Type a query: { field: 'value' } Reset Apply Options

```
{
  "titleArr": Array (empty),
  "__v": 0
}
```

```
{
  "_id": ObjectId('6748589b2e854ec40965f0f4'),
  "username": "TSD",
  "password": "$2b$10$CPGUwYQ32E8uG2YBjuEtmvYb1rKarnLwGT507envKM74bNx35Ke1w",
  "prn": "000000",
  "arr": Array (1),
  "titleArr": Array (1),
  "__v": 0
}
```

```
{
  "_id": ObjectId('68955d1549aedb42acc23282'),
  "username": "saurabhsd",
  "password": "$2b$10$HwtXdz7VU1G0GF0bTG.0u3dhuvC5kCdRACU9C8p2dHv9x6koTC6.",
  "__v": 0
}
```

System Status: All Good

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