INI8 LABS Assignment

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Github Repository URL:
Frontend: https://github.com/AmanJ10/pdf-upload-application-frontend
Backend: https://github.com/AmanJ10/pdf-upload-application-backend

1. Tech Stack Choices

Q1. What frontend framework did you use and why?

I used **React** for the frontend. React's component-based architecture made it easy to build reusable UI components and maintain a clean structure. It efficiently manages UI state, handles routing effectively with React Router, and integrates smoothly with RESTful APIs.

Q2. What backend framework did you choose and why?

I chose **Express.js** for the backend because it is lightweight, fast which gives me full control over how I structure the API. Express integrates seamlessly with Node.js, providing a clean way to build RESTful APIs. It also has a large ecosystem of middleware (like **Multer** for file uploads and CORS for security), which made it easy to implement features such as document upload and routing.

Also, both the frontend and backend are written in a single language (JavaScript).

Q3. What database did you choose and why?

I chose **PostgreSQL** as the database for this project because it is a powerful, reliable, and production-grade relational database. It supports strong data consistency, ACID transactions.

Prisma is a next-generation Object-Relational Mapper (ORM) that simplifies database interactions by providing a type-safe query builder and an intuitive API for Node.js and TypeScript applications. Instead of writing raw SQL, developers use JavaScript functions to

interact with the database, and Prisma handles the conversion to SQL, improving developer productivity and preventing errors like SQL injections.

Q4. If you were to support 1,000 users, what changes would you consider?

To support 1,000+ users, I would focus on improving scalability, performance, and reliability across the stack:

1. Backend Scaling

- Move the Express server behind a **reverse proxy** like Nginx.
- Enable **horizontal scaling** by running multiple Node.js instances.
- Add **rate limiting** and **request validation** to protect the API from overload.
- Add **load balancing** so requests are evenly distributed. For this, we can use Nginx too, and use an appropriate algorithm of load balancing like Round Robin or FCFS (First Come First Served).

2. Database Optimisation

- To support 1,000+ users, I would add indexes on frequently queried columns (e.g., `id`, `createdAt`, `userId etc. in future`) to speed up lookups. This reduces full table scans, improves query performance, and lowers database load.
- The N+1 problem occurs when the system performs one main query and then executes an additional query for every result returned. For example, fetching 100 documents and then executing 100 separate queries to fetch each document's user. This results in 101 queries instead of a single optimized JOIN. Avoiding N+1 queries improves performance and scalability.

3. File Storage Optimisation (for PDFs/images)

- Move uploaded files from local storage to a cloud service like:
  - **AWS S3**,
  - Firebase Storage, or
  - Google Cloud Storage.
- This reduces server load and improves global access speed.

4. Caching

- Introduce **Redis caching** for frequent data retrieval.
- Cache metadata of documents or user data to reduce load on Postgres.
- Also, ensure there is no stale data either in the DB or Redis.

5. Frontend Improvements

- Use **code-splitting** and **lazy loading** to speed up initial load.

- Optimise API calls and cache responses with React Query/RTK Query.

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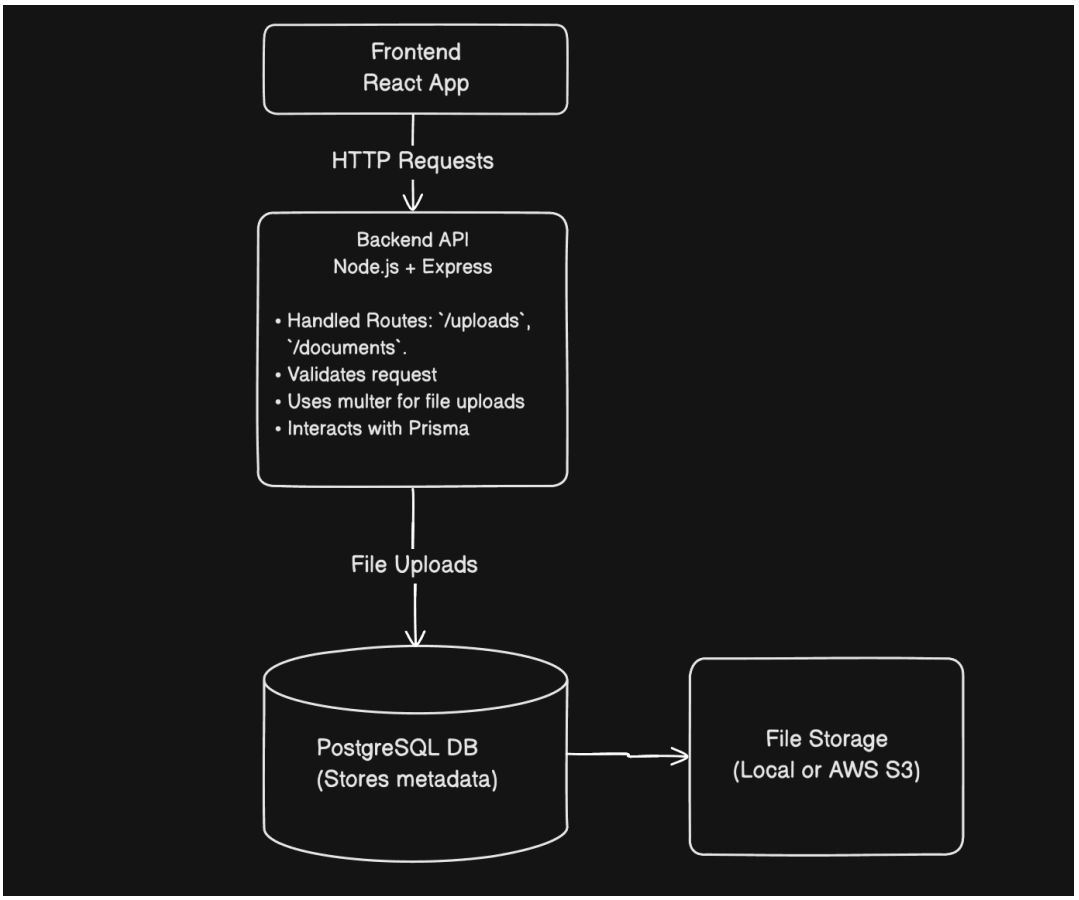
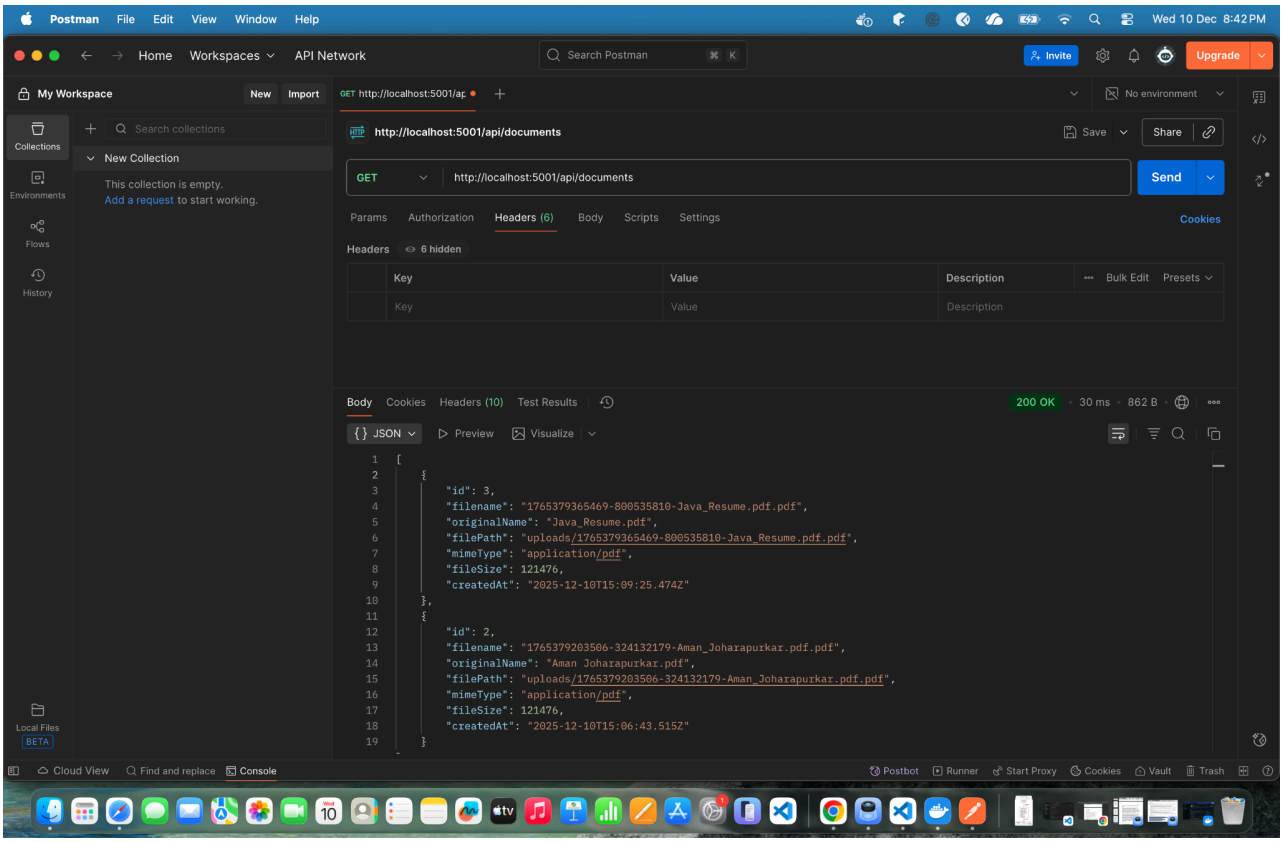
2. Architecture Overview (made using Draw.io)

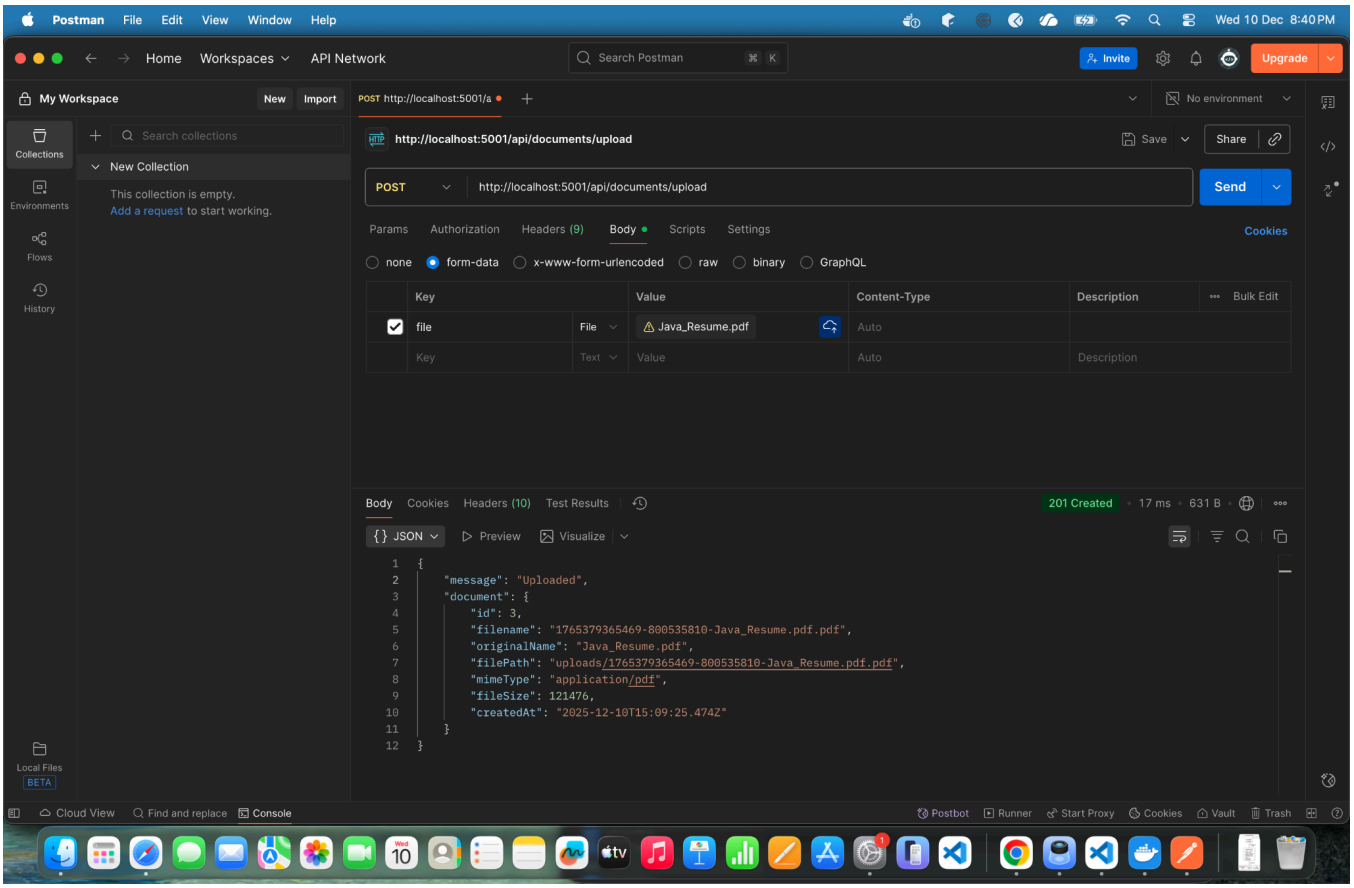


3. API Specification

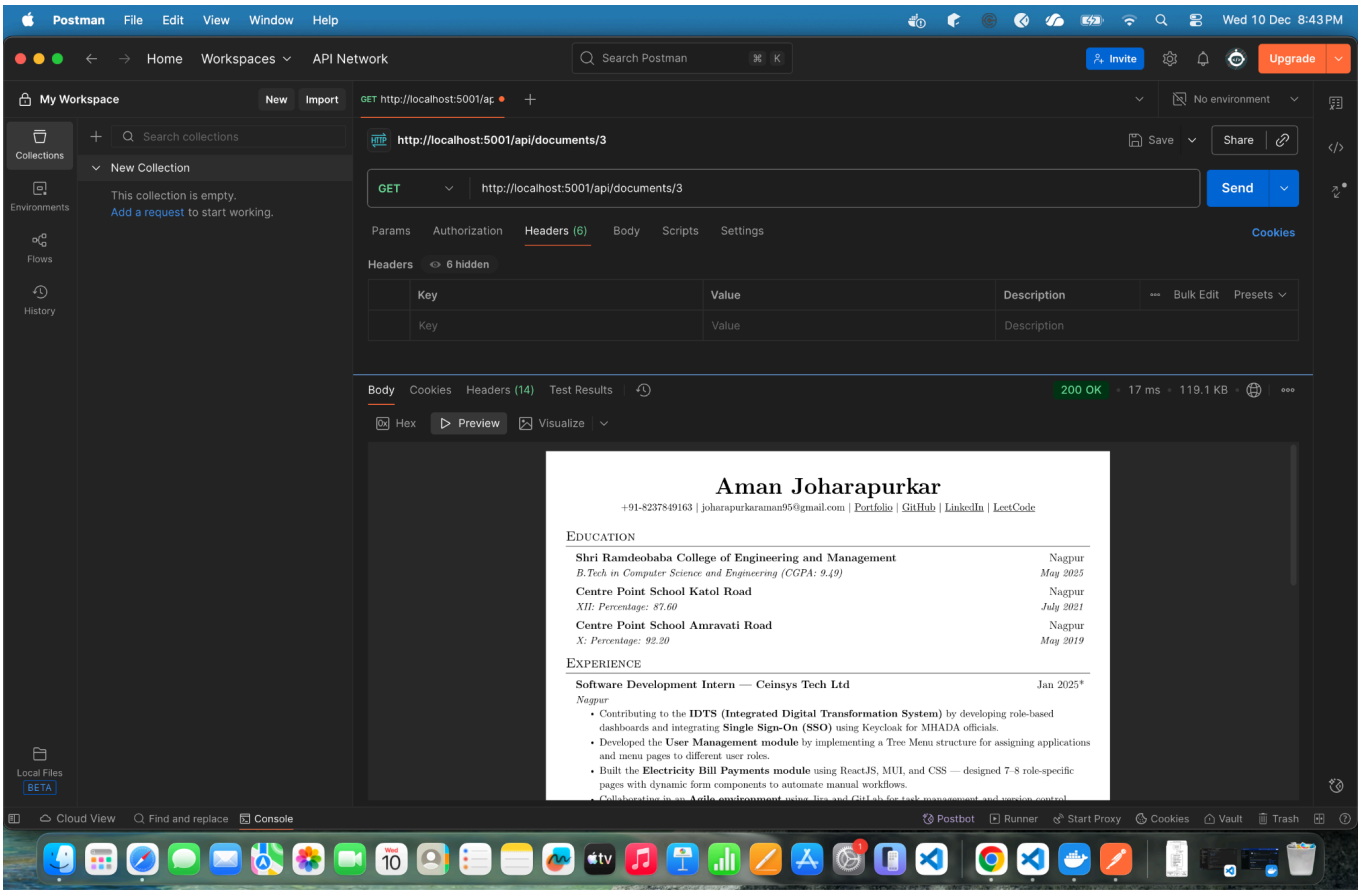
1.) GET Documents:
API Endpoint: http://localhost:5001/api/documents
Method: GET
Sample Request & Response (using Postman):



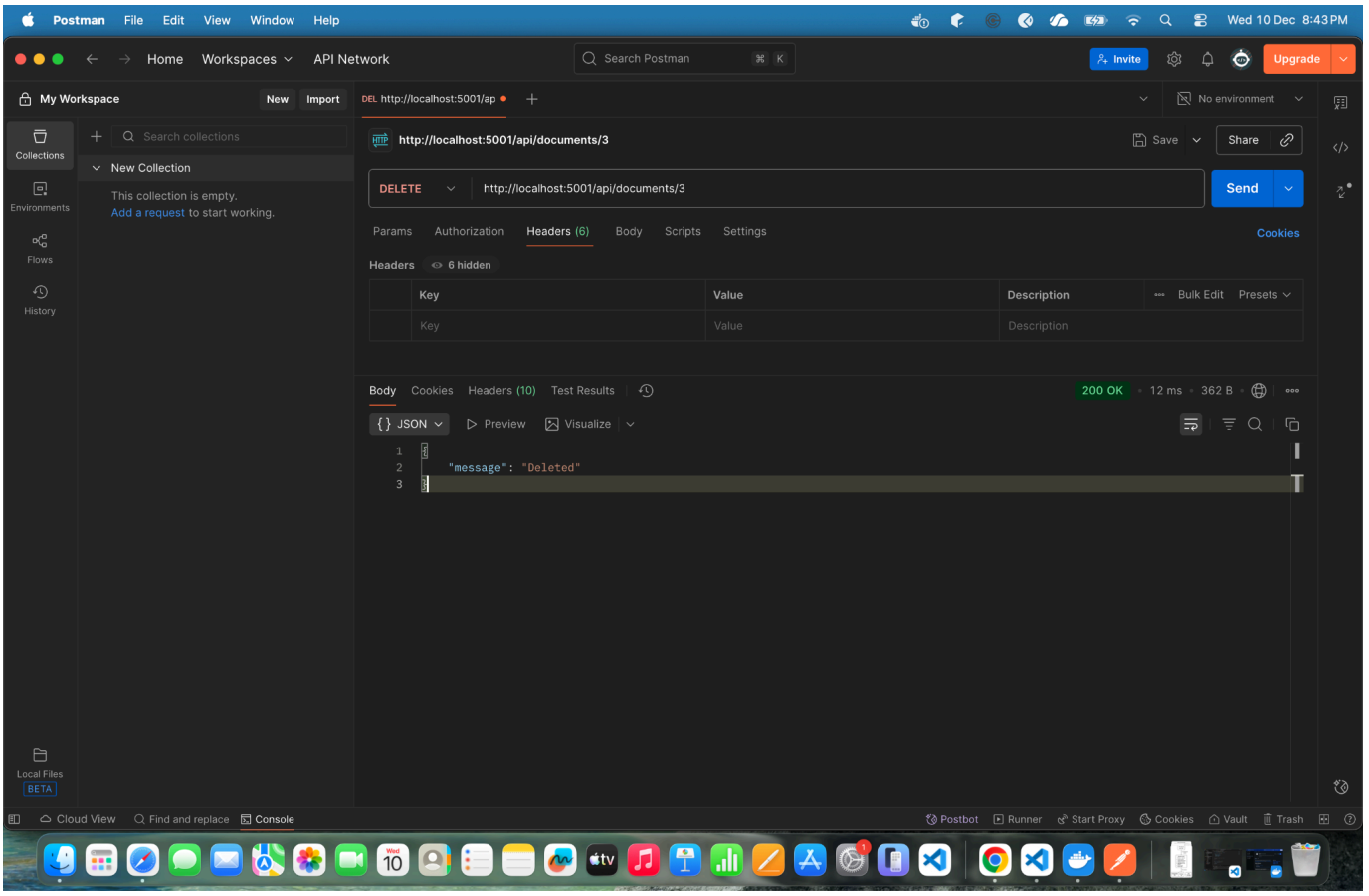
2.) Upload a Document:
API Endpoint: http://localhost:5001/api/documents
Method: POST
Sample Request & Response (using Postman):



3.) Get a Particular Document (Download):
API Endpoint: http://localhost:5001/api/documents/{id}
Method: GET
Sample Request & Response (using Postman):



4.) Delete Document:
API Endpoint: http://localhost:5001/api/documents/{id}
Method: DELETE
Sample Request & Response (using Postman):



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4. Data Flow Description

File Uploading:

1.) User selects a file on the React frontend.

The frontend sends a `multipart/form-data` POST request to:

POST /documents/upload

2.) **Express receives the request.**

The `/upload` route is protected by multer middleware:

upload.single("file")

Multer extracts the file from the request and stores it in your configured upload folder (`uploads/`).

3.) **Multer attaches file info to `req.file`.**

```
{
  "filename": "abc123.pdf",
  "originalname": "report.pdf",
  "path": "uploads/abc123.pdf",
  "mimetype": "application/pdf",
  "size": 204800
}
```

4.) **Controller `uploadDocument` runs.**

Reads metadata from the `req.file`

Saves metadata to PostgreSQL using Prisma:

```
await prisma.document.create({
  data: {
    filename,
    originalName,
    mimeType,
    size,
    path
  }
```

})

5.) **The database stores only metadata.**

id	orignialName	fileName	filePath	mimeType	size	path	createdAt

6.) **API returns a success response** to the frontend:


```
{
   "message": "Uploaded",
   "document": {
      "id": 4,
      "filename":
"1765422247761-573017703-Aman_Joharapurkar-Internship_Report.pdf.pdf",
      "originalName": "Aman Joharapurkar-Internship Report.pdf",
      "filePath":
"uploads/1765422247761-573017703-Aman_Joharapurkar-Internship_Report.pdf.pdf
",
      "mimeType": "application/pdf",
      "fileSize": 1718877,
      "createdAt": "2025-12-11T03:04:07.786Z"
   }
}
```


7.) **Frontend updates UI** (refreshes list of documents).

File Download:

1.) **The user clicks Download in the frontend.**

A GET request hits:

GET /documents/:id

2.) **The Express route calls:**

prisma.document.findUnique({ where: { id } })

3.) **Database returns file metadata, including file path.**

4.) **The backend checks whether the file exists on disk.**

5.) **Express sends the actual file using:**

res.download(filePath, originalName)

6.) **The browser receives the file and triggers a download.**

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5. Assumptions

While designing and implementing the file upload & document management system, I made the following assumptions:

1.) Only one user:
   a.) No login/logout authentication system.

2.) File Types Allowed:
   a.) Only PDFs are allowed. No JPG, PNG files.

3.) Storage:
   a.) Used Local storage for saving the uploaded images.
   b.) In production, and to optimise file storage, we can use AWS S3, Firebase or cloud storage.

4.) Validation:
   a.) File size limit is 10 MB. User cannot upload a file which is more than 10MB.
   b.) User cannot upload multiple files at the same time.