An Introduction to Web Development Applications

using React, Node.JS, Rest API

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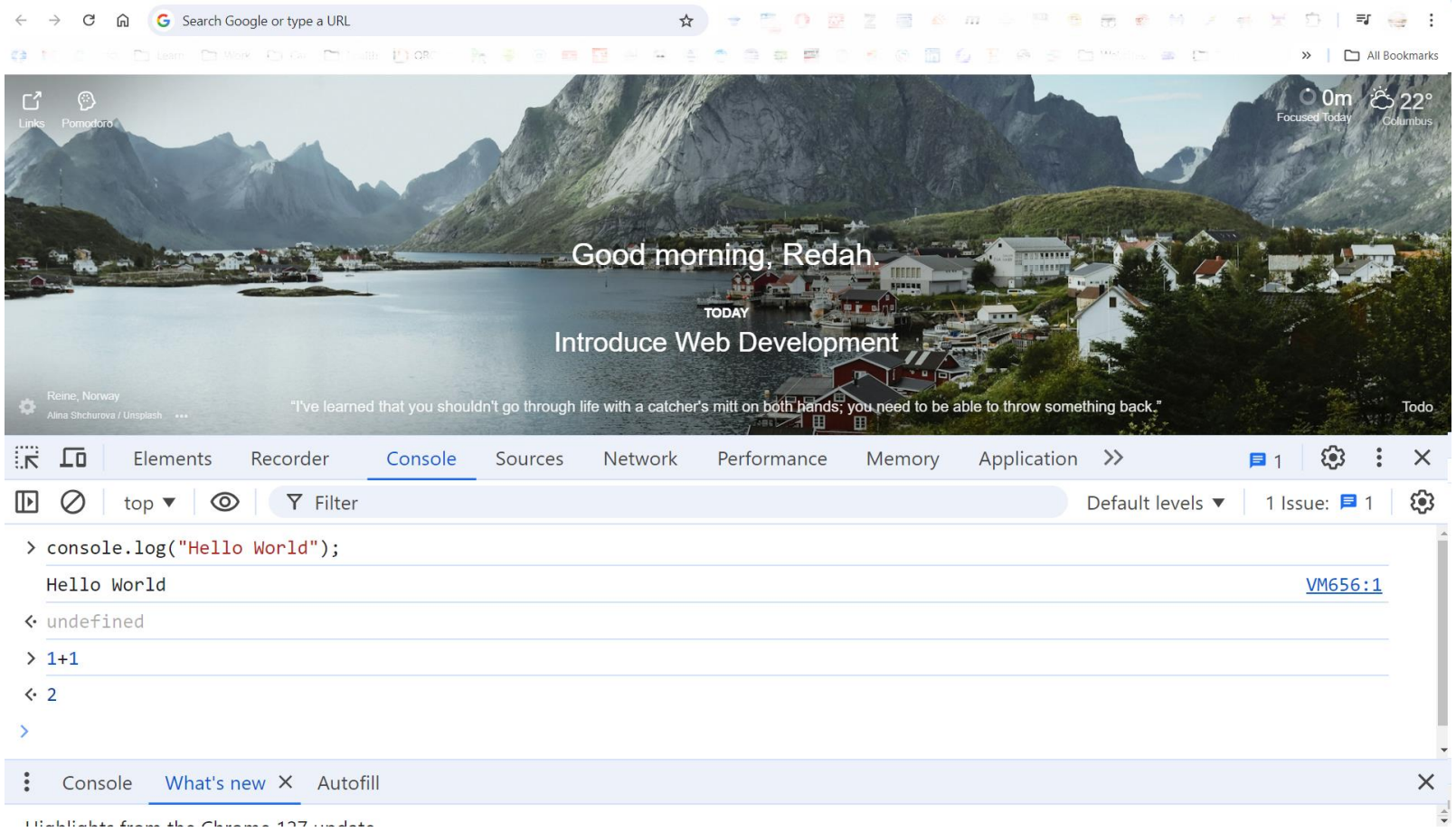
Content

1. Background
2. Front End
3. Back End
4. Rest API
5. Quick Practice

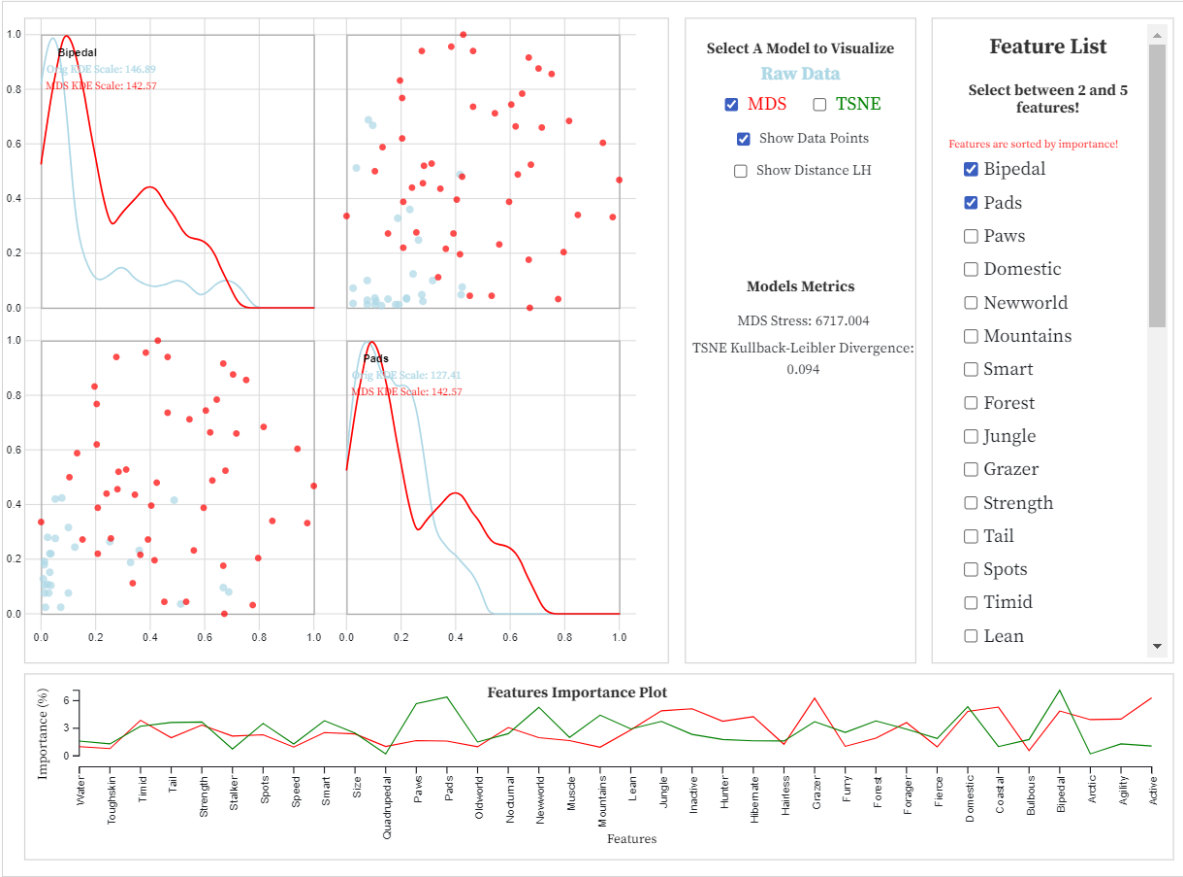
JavaScript (JS)

An object-oriented programming language commonly used to create interactive effects within web browsers.



JavaScript (JS)

- https://observablehq.com/d/90c2da14198e0b68



Node.JS: Runtime Environment

https://nodejs.org/en

node.js Learn About Download Blog Docs Certification

Start typing... Ctrl K

Run JavaScript Everywhere

Node.js® is a free, open-source, cross-platform JavaScript runtime environment that lets developers create servers, web apps, command line tools and scripts.

Download Node.js (LTS)

Downloads Node.js **v20.16.0**[1] with long-term support.
Node.js can also be installed via package managers.

Want new features sooner? Get **Node.js v22.5.1**[1] instead.

Create an HTTP Server | Write Tests | Read and Hash a File | Streams Pipeline | Work with Thread

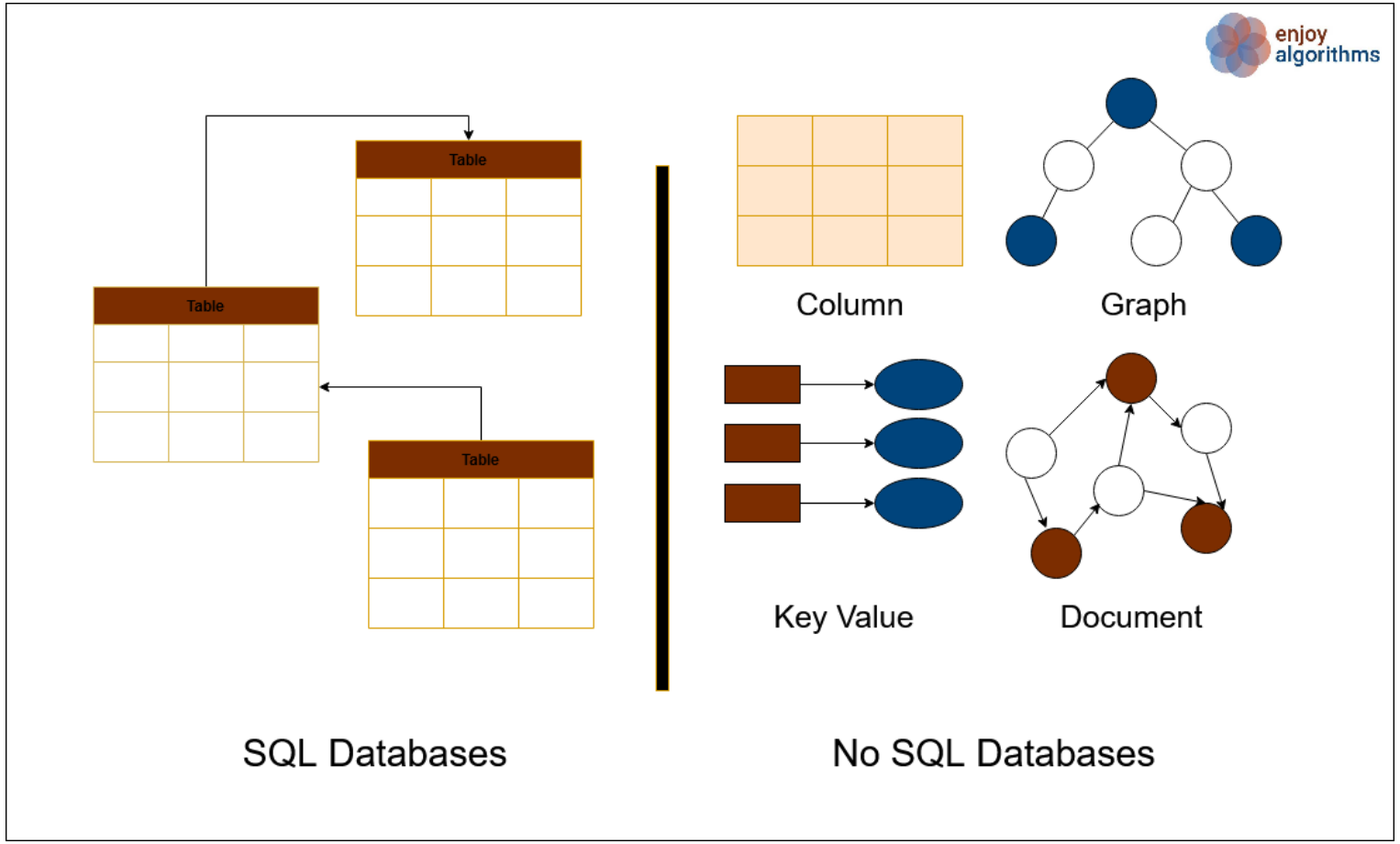
```javascript
// server.mjs
import { createServer } from 'node:http';

const server = createServer((req, res) => {
  res.writeHead(200, { 'Content-Type': 'text/plain' });
  res.end('Hello World!\n');
});

// starts a simple http server locally on port 3000
server.listen(3000, '127.0.0.1', () => {
  console.log('Listening on 127.0.0.1:3000');
});

// run with `node server.mjs`
```

JavaScript Copy to clipboard

Learn more what Node.js is able to offer with our Learning materials.

SQL vs NoSQL Databases

MySQL,
MSSQL
PostgreSQL



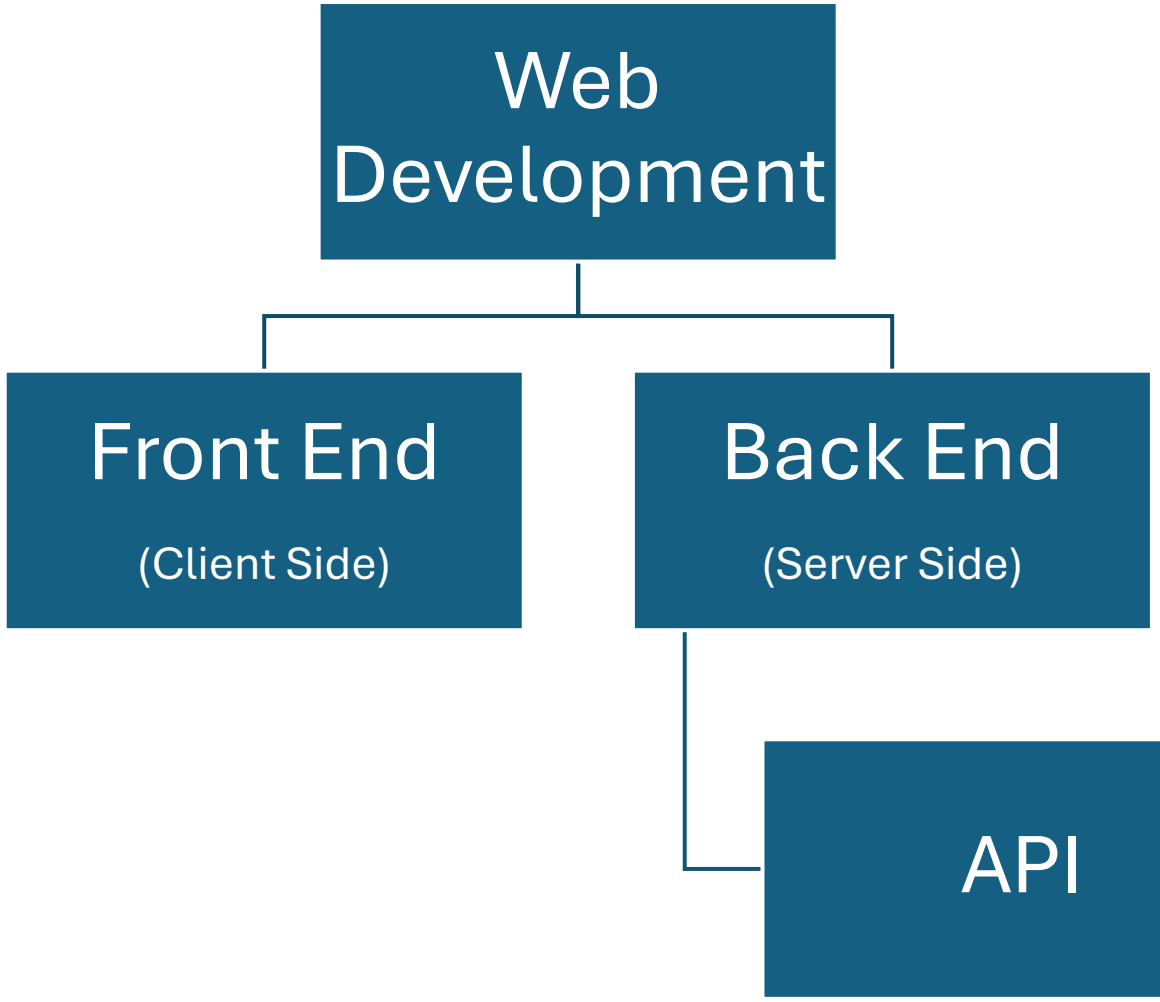
Key-Value Pair:
- **Redis,**
- **DynamoDB,**

Document:
- **MongoDB,**
- **Apache Hbase**

Graph:
- **Neo4J,**
- **Amazon Neptune**

Multi-modal:
- **ArangoDB,**
- **OrientDB**

Web-Development



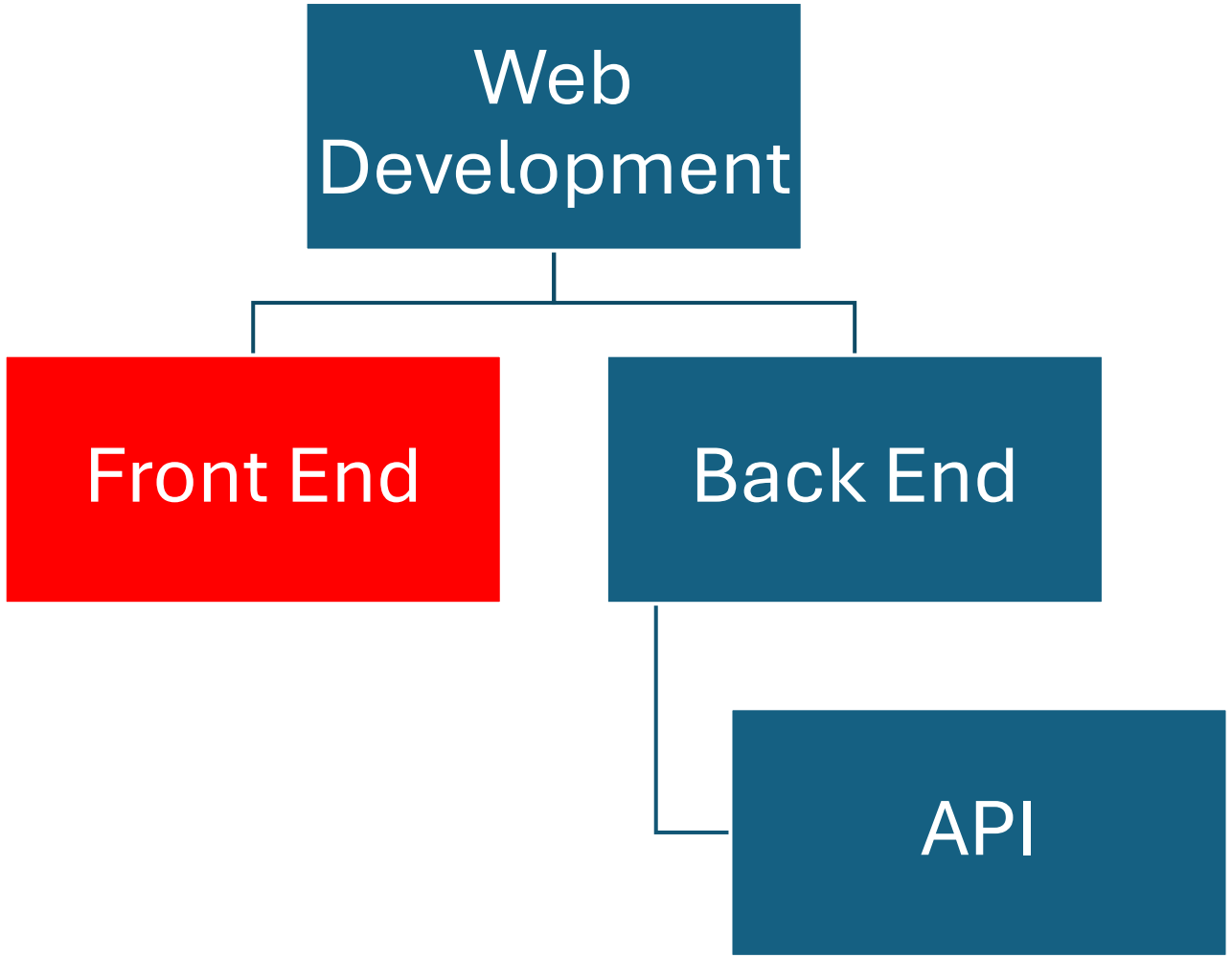
This is what you/user will see.

This is where you do calculations, verifications, ...etc.

This is how to reach the backend/server

Each API does some calculation/verification

Web-Development

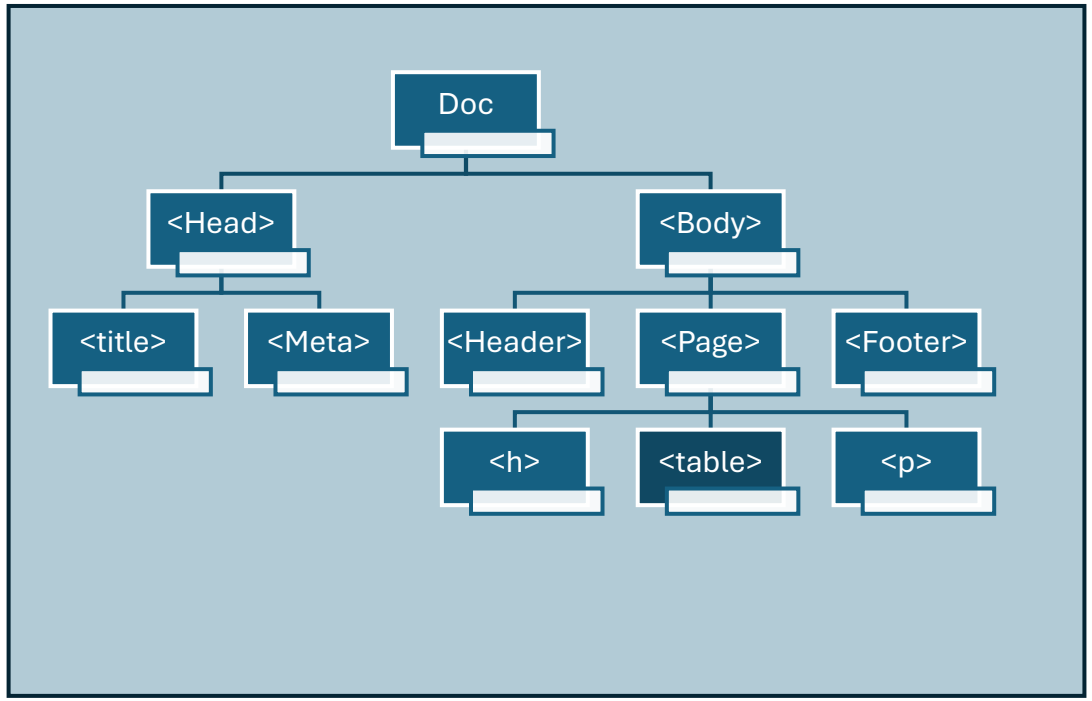


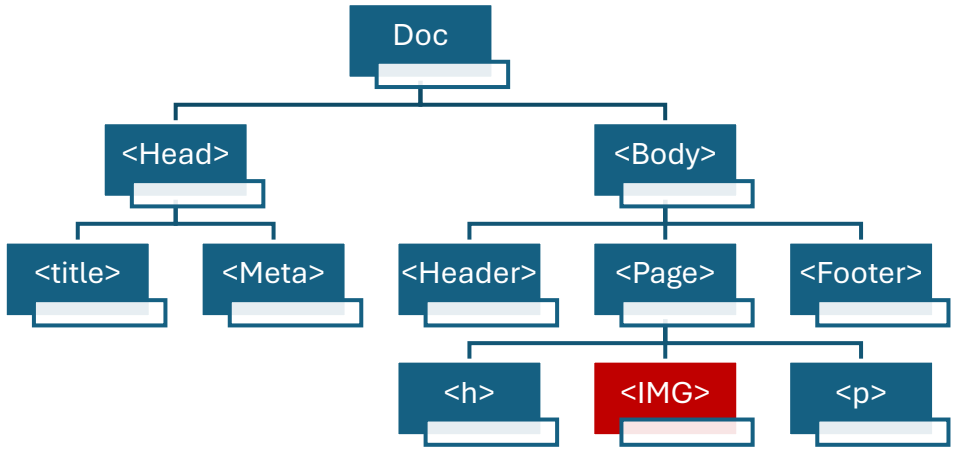
Traditional Web App Development!

Website (Actual DOM)
What you see

Replace

Website (New DOM)
New Page





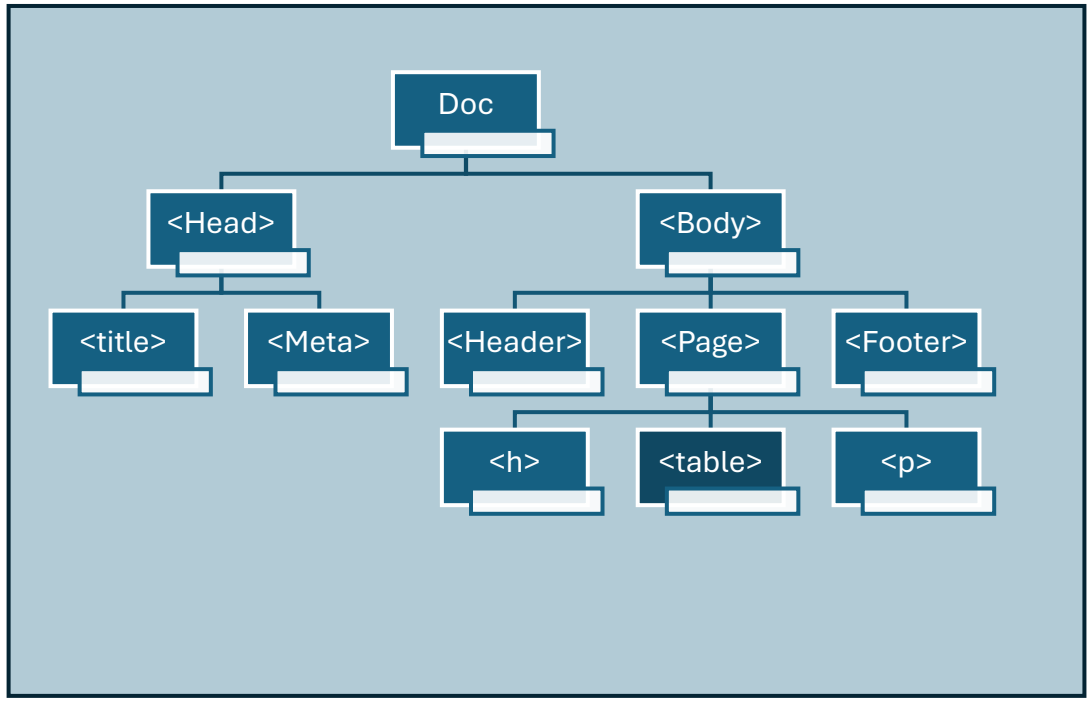
React – An Optimized Development!

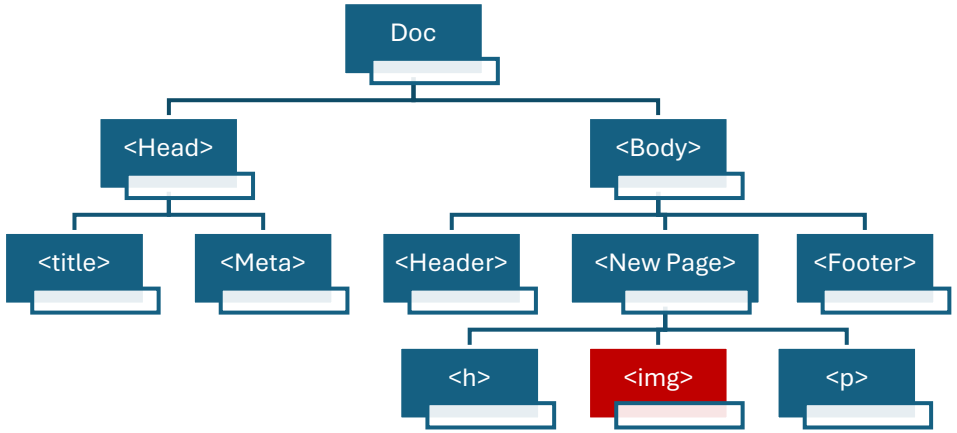
- React is a JavaScript library for building user interfaces with **reusable** components, using state management and a virtual DOM for efficient updates.

Website (Actual DOM)
What you see

Update

Virtual DOM





React – Get started!

- React is a JavaScript library for building user interfaces with **reusable** components, using state management and a virtual DOM for efficient updates.

```
>> npx create-react-app <<ProjectName>>

Creating a new React app in C:\Users\aaredah\temp\frontend.

Installing packages. This might take a couple of minutes.
Installing react, react-dom, and react-scripts with cra-template...


added 1480 packages in 47s

261 packages are looking for funding
  run `npm fund` for details

Initialized a git repository.

Installing template dependencies using npm...

added 63 packages, and changed 1 package in 8s

261 packages are looking for funding
  run `npm fund` for details
Removing template package using npm...
```

```
> node_modules
> public
v src
  # App.css
  JS App.js
  JS App.test.js
  # index.css
  JS index.js
  logo.svg
  JS reportWebVitals.js
  JS setupTests.js
  .gitignore
  {} package-lock.json
  {} package.json
  ⓘ README.md
```

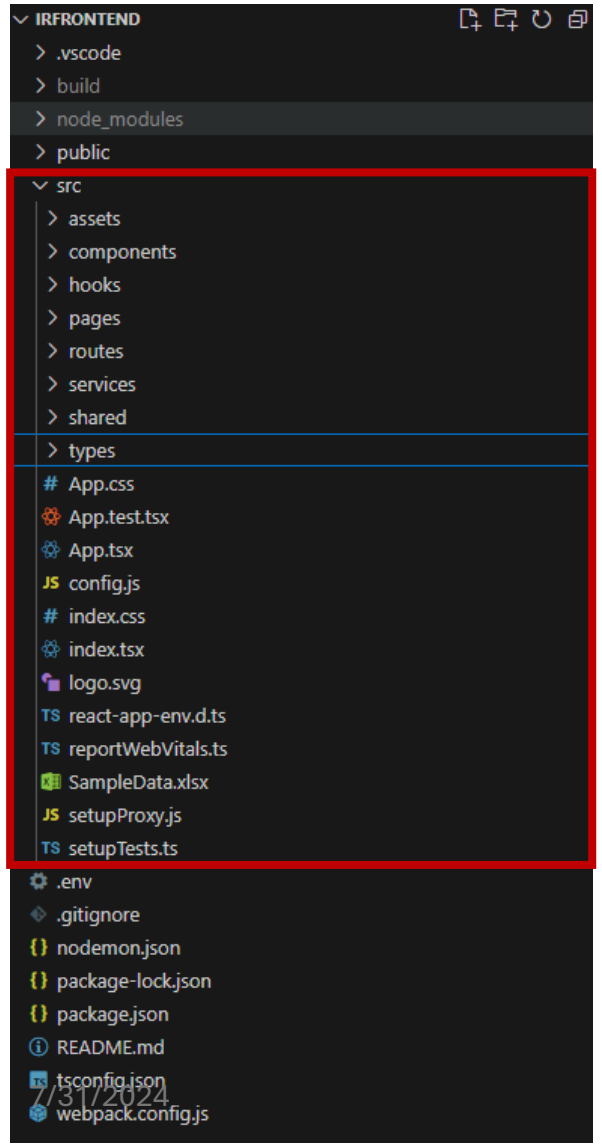
React – Get started!

- Toolchains:
  - If you're **creating a new single-page app,** use Create React App.
  - If you're building a **server-rendered website with Node.js,** try Next.js.
  - If you're building a **static content-oriented website,** try Gatsby.
  - If you're building a **component library** or **integrating with an existing codebase**, try More Flexible Toolchains.

```
>> npx create-next-app@latest my-next-app
Need to install the following packages:
create-next-app@14.2.5
Ok to proceed? (y)

√ Would you like to use TypeScript? ... No / Yes
√ Would you like to use ESLint? ... No / Yes
√ Would you like to use Tailwind CSS? ... No / Yes
√ Would you like to use `src/` directory? ... No / Yes
√ Would you like to use App Router? (recommended) ... No / Yes
√ Would you like to customize the default import alias (@/*)? ... No / Yes
Creating a new Next.js app in C:\Users\aaredah\temp\my-next-app.

Using npm.

Initializing project with template: app


Installing dependencies:
- react
```

```
> node_modules
> public
v src\app
  favicon.ico
  globals.css
  layout.tsx
  page.module.css
  page.tsx
  .gitignore
  next-env.d.ts
  next.config.mjs
  package-lock.json
  package.json
  README.md
  tsconfig.json
```

React – typical structure

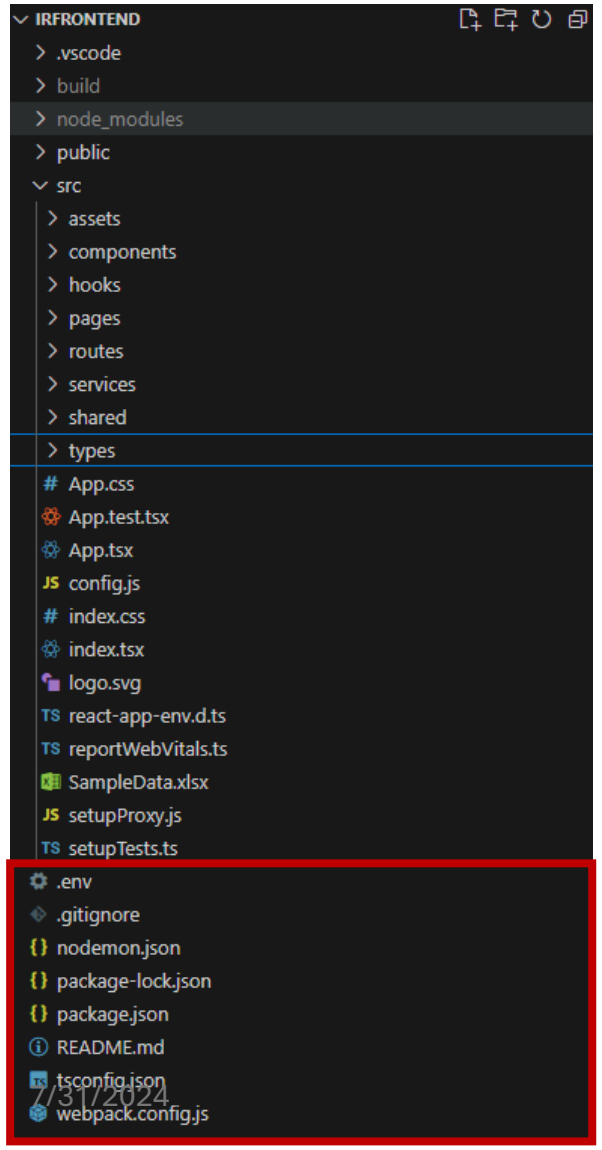


OPTIONAL

- **src/:** The main source directory containing all the code for the application
  - **assets/:** Contains static assets such as images, fonts, and other media files
  - **components/:** For reusable UI components. Each component typically has its own folder containing the component file and its styles
  - **hooks/:** Contains custom React hooks. Hooks are functions that let you use state and other React features in functional components
  - **pages/:** Contains the main page components. Each page represents a different route/view
  - **routes/:** Contains the route configuration for the application. It defines how different URLs map to different pages or components.
  - **services/:** This directory holds the logic for interacting with external APIs or performing data-related operations. It often contains functions for making HTTP requests (calling API's)
  - **shared/:** This folder includes shared utilities, helper functions, or constants that are used across the application
  - **types/:** This directory is for TypeScript type definitions.
  - **index.tsx**: The entry point of the React application. It renders the App component into the root element in the HTML file
  - **config.js**: Configuration file for the application, which might include environment-specific settings and constants

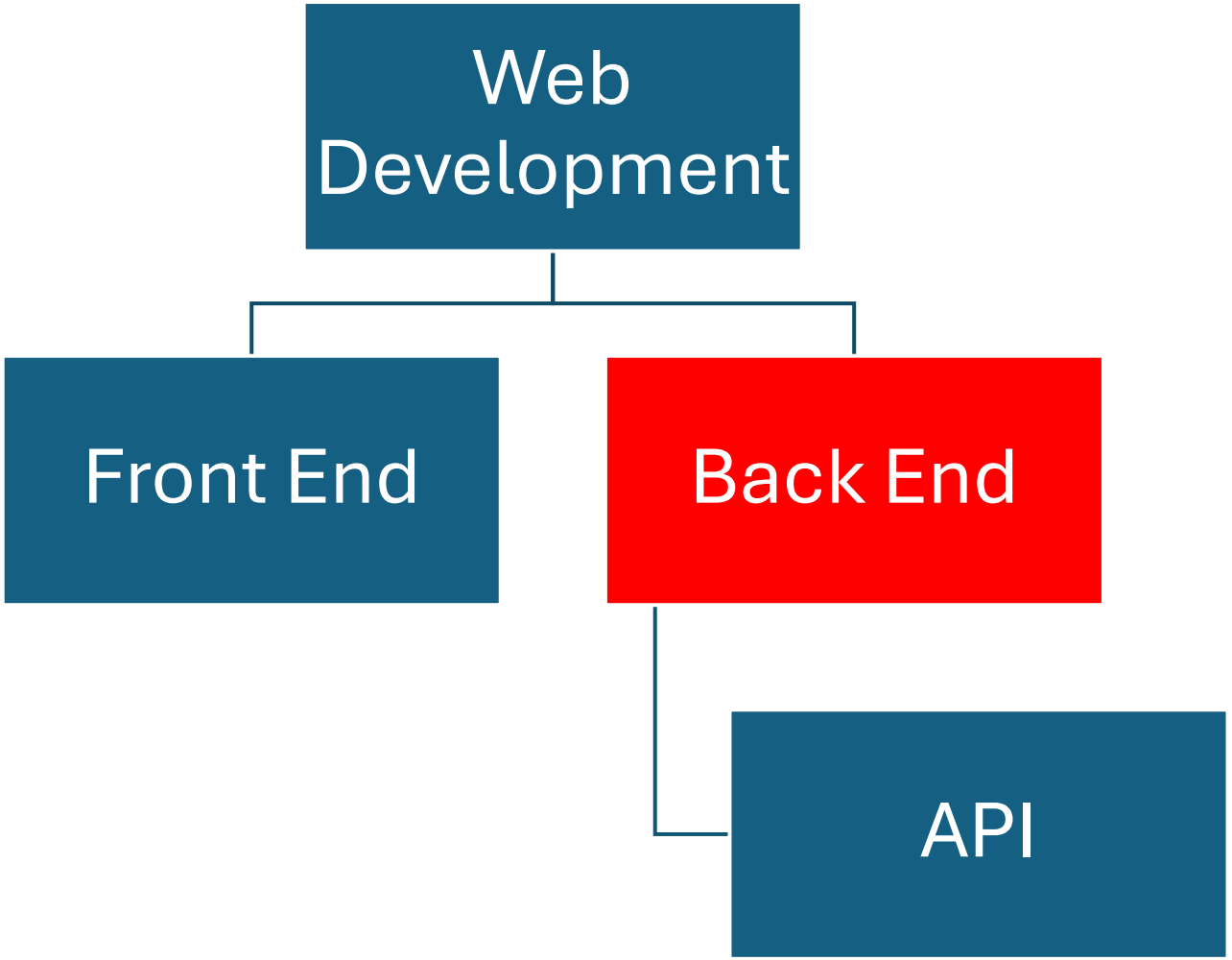
React – typical structure

OPTIONAL



- .env: Environment variables file. It stores environment-specific configuration variables that can be accessed using process.env
- **package.json**: This file contains metadata about the project and its dependencies. It is used by npm/Yarn to manage the project's packages.

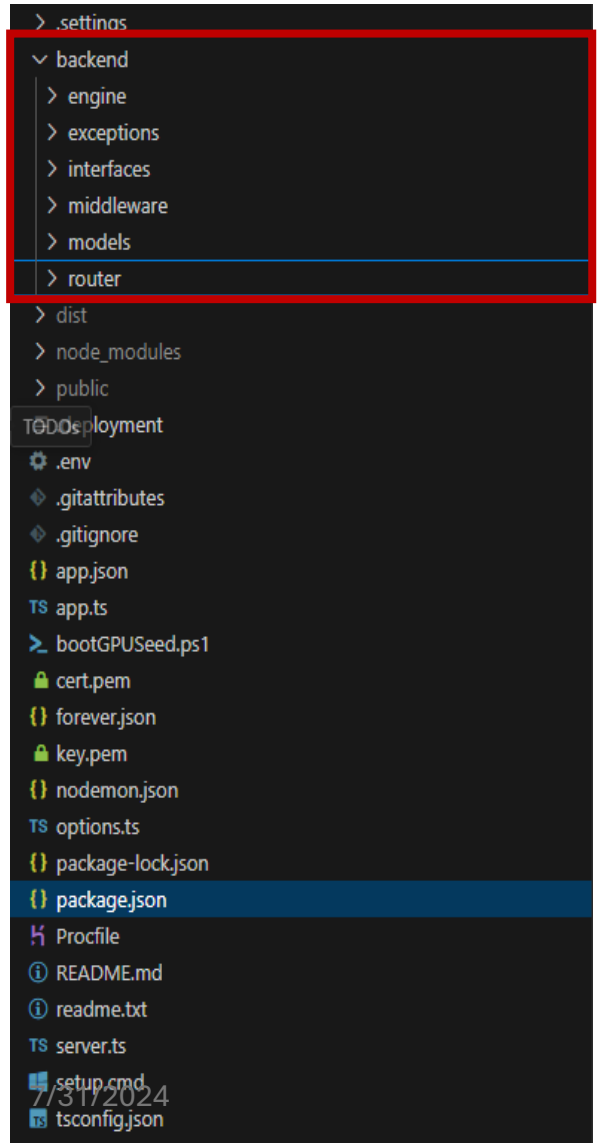
Web-Development



Web-Development

- Backend could be any programming language
  - **Node.JS**
  - **Python**
  - Java
  - PHP
  - …

Node.JS – typical structure



- **backend/**: <u>The root directory</u> of your Node.js backend application.
  - **engine/**: Contains the core logic of the application.
  - **exceptions/**: For custom error classes and exception handling logic.
  - **interfaces/**: Contains TypeScript interfaces and types used throughout the application.
  - **middleware/**: Middleware functions that process requests before they reach the route handlers. Middleware can be used for tasks like authentication, logging, and request validation.
  - **models/**: This folder contains the data models that represent the structure of your data and define the schema for interacting with the database.
  - **router/**: This directory holds the route definitions for your application. Each file in this folder typically corresponds to a specific set of routes (e.g., user routes) and connects the routes to their respective controllers.

OPTIONAL

- **app.ts**: This is the main entry point for your application. It sets up the Express app configures middleware, and loads the routes. This file is usually responsible for starting the server.
- **package.json**: This file contains metadata about the project, including dependencies, scripts, and other configurations. It's essential for managing the project's dependencies and scripts using npm.

Python Backend App

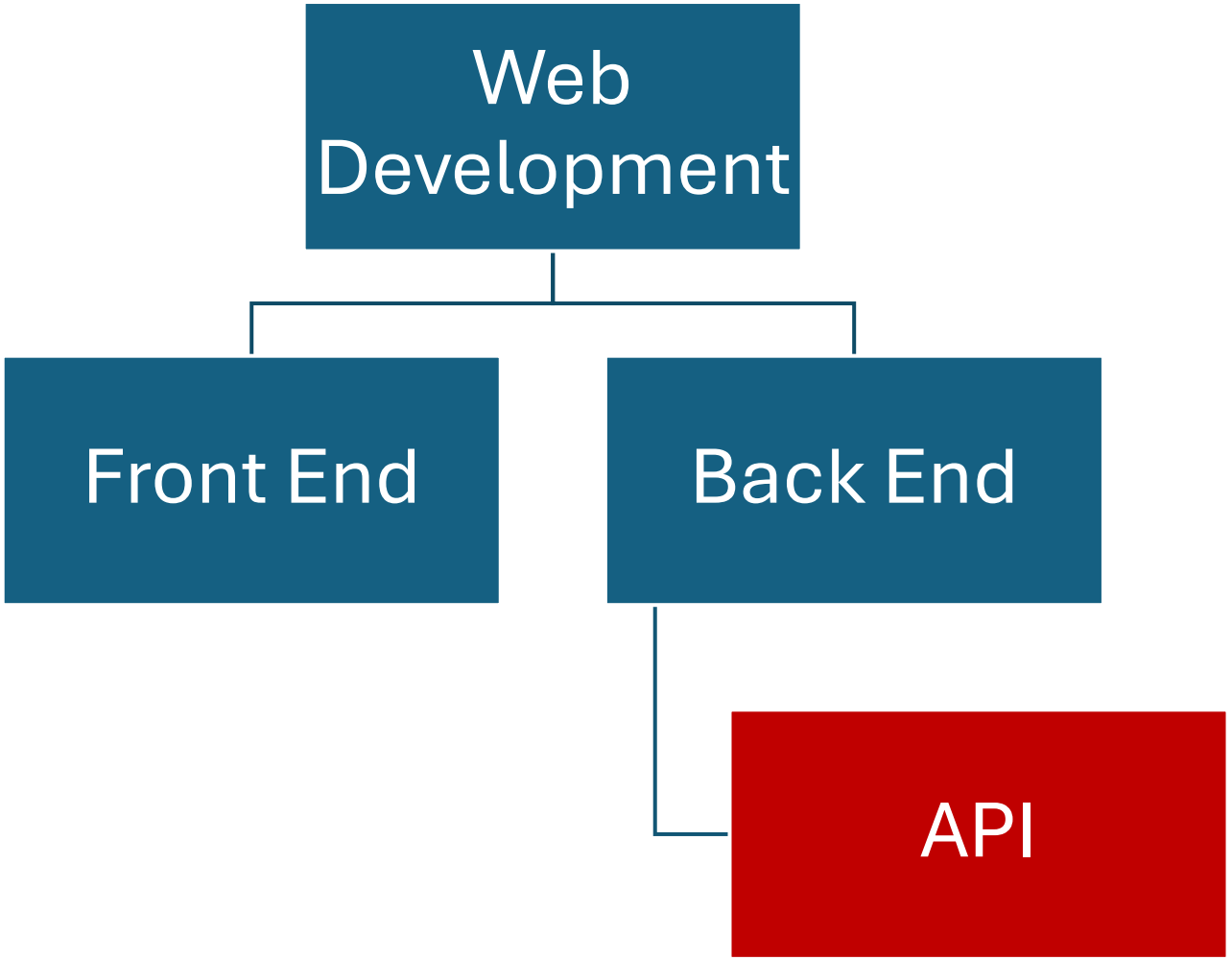
app.py

```python
from flask import Flask
from routes import blueprint
from flask_cors import CORS


app=Flask(__name__)
CORS(app)
CORS(blueprint)

app.register_blueprint(blueprint, url_prefix='/')

if __name__ == '__main__':
    app.run(host='0.0.0.0', port=5000, debug=True)
```

routes.py

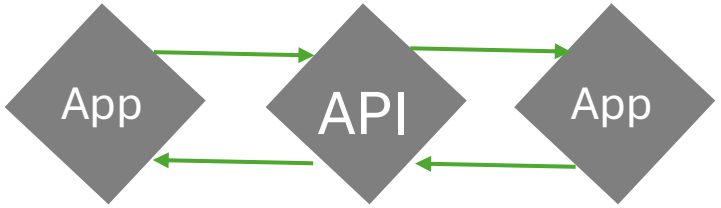
```python
from flask import Blueprint, render_template_string, render_template, jsonify
from flask_cors import CORS
import os
import dvcalculator

# Create a Blueprint
blueprint = Blueprint('blueprint', __name__)
CORS(blueprint)  # Enable CORS for the blueprint

@blueprint.route('/ems/get_materials_list', endpoint='ems/get_materials_list')
def get_materials_list():
    material_path = './asset/DeductValue/'  # Replace with your folder path
    materials = [f.name for f in os.scandir(material_path) if f.is_dir()]
    return jsonify(materials)

@blueprint.route('/ems/get_type_list/<material>', endpoint='ems/get_type_list')
def get_type_list(material):
    material_path = './asset/DeductValue/'+ material
    types = [f.name for f in os.scandir(material_path) if f.is_dir()]
    # Using join with a newline separator
    print("\n".join(types))
    return jsonify(types)
```

Web-Development



What is an API

- Application Program Interface
- Contact between 2 applications (either to do something to get data)



What is REST?

- **Re**presentational **S**tate **T**ransfer
  - **Representational**: The server sends the representation of a resource to the client in formats like **JSON** or **XML.**
  - **State**: The state of a client session is maintained on the client side, not on the server.
  - **Transfer**: the communication of data between the client and server.
- Relies on a stateless[1], client-server protocol (HTTP)
- Can be used by almost any programming language

1. A communication method that allows the server to handle each client request independently of previous requests.

Common HTTP Methods

- **GET**: Retrieve data from a specified resource
- **POST**: Submit data to be processed to a specified resource
- **PUT**: Update a specified resource
- **DELETE**: Delete a specified resource

Endpoints (sending a request)

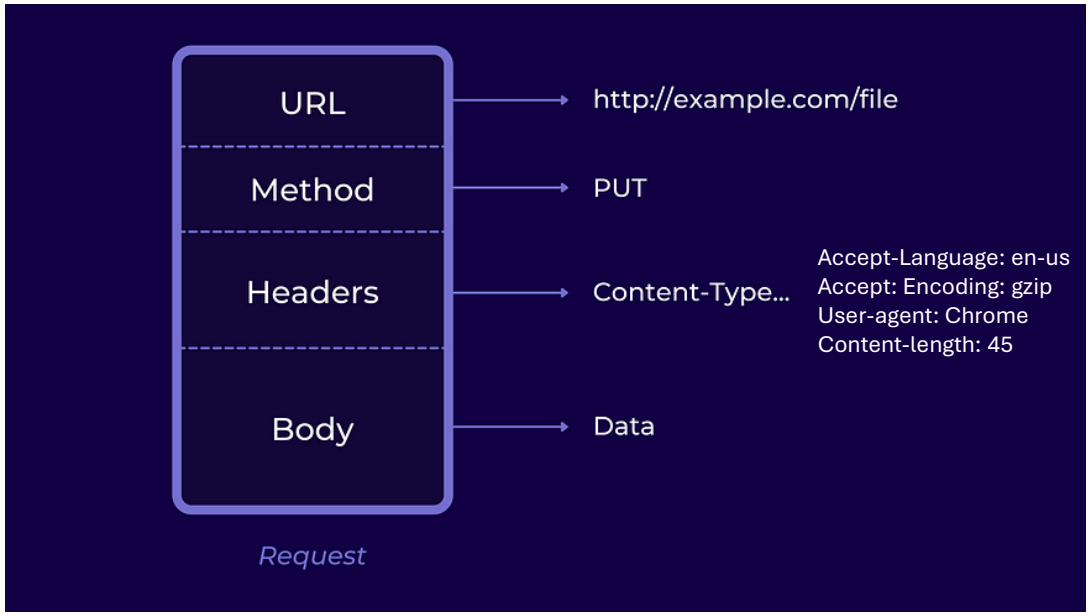
- URL where API can be accessed by a client application

• GET	https://site.com/api/users	(get all users)
• GET	https:site.com/api/users/1	(get user with id: 1)
• POST	https:site.com/api/users	(add a user)
• PUT	https:site.com/api/users/1	(update a user details)
• DELETE	https:site.com/api/users/1	(deletes user of id: 1)

Common HTTP Methods

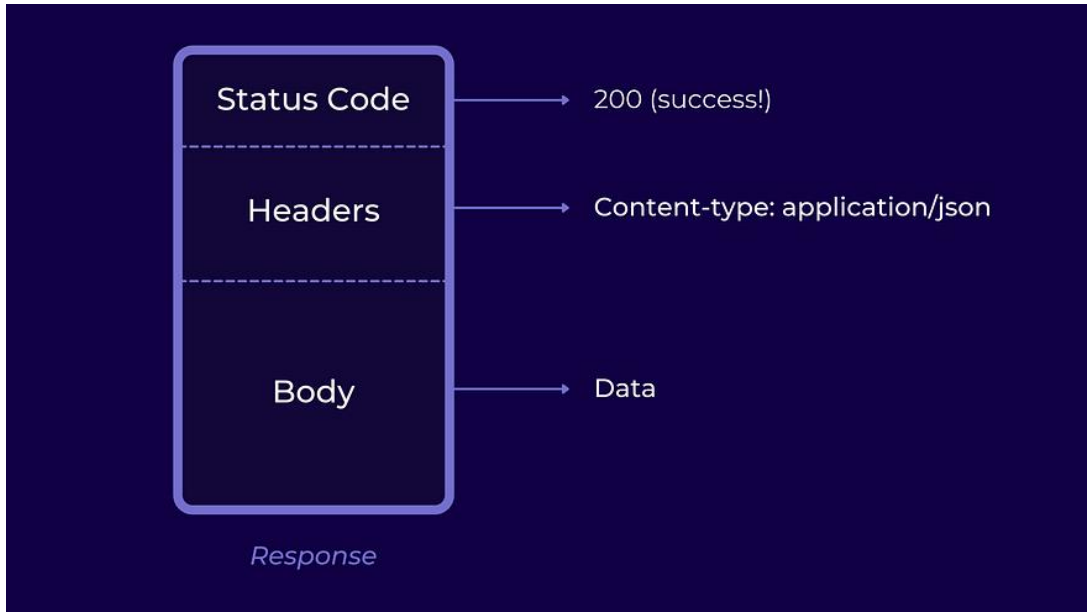
Sending a request to the server

Request structure



Getting a response from the server

Response structure



Example

```
>> curl https://api.github.com/users/ahmedaredah
```

```
C:\Users\aaredah>curl https://api.github.com/users/ahmedaredah
{
  "login": "AhmedAredah",
  "id": 77444744,
  "node_id": "MDQ6VXNlcjc3NDQ0NzQ0",
  "avatar_url": "https://avatars.githubusercontent.com/u/77444744?v=4",
  "gravatar_id": "",
  "url": "https://api.github.com/users/AhmedAredah",
  "html_url": "https://github.com/AhmedAredah",
  "followers_url": "https://api.github.com/users/AhmedAredah/followers",
  "following_url": "https://api.github.com/users/AhmedAredah/following{/other_user}",
  "gists_url": "https://api.github.com/users/AhmedAredah/gists{/gist_id}",
  "starred_url": "https://api.github.com/users/AhmedAredah/starred{/owner}{/repo}",
  "subscriptions_url": "https://api.github.com/users/AhmedAredah/subscriptions",
  "organizations_url": "https://api.github.com/users/AhmedAredah/orgs",
  "repos_url": "https://api.github.com/users/AhmedAredah/repos",
  "events_url": "https://api.github.com/users/AhmedAredah/events{/privacy}",
  "received_events_url": "https://api.github.com/users/AhmedAredah/received_events",
  "type": "User",
  "site_admin": false,
  "name": "Ahmed Aredah",
  "company": "Virginia Tech",
  "blog": "",
  "location": "Blacksburg, VA, USA",
  "email": null,
  "hireable": null,
  "bio": "A research Assistant at @VirginiaTech ",
  "twitter_username": null,
  "public_repos": 33,
  "public_gists": 1,
  "followers": 18,
  "following": 22,
  "created_at": "2021-01-14T12:59:51Z",
  "updated_at": "2024-07-15T12:19:28Z"
}
```

```
>> curl -X POST https://api.github.com/user/repos \
-H "Authorization: token YOUR_TOKEN" \
-H "Content-Type: application/json" \
-d '{"name":"new-repo-name", "description":"This is a new repository", "private":false}'
```

Node.JS Router - Real Example

Back End (REST API)

```
private initializeRoutes(){
  this.router.post(`${this.path}/login`, this.loggingIn);//authMiddleware,
}

//get the contact with id
private loggingIn = async (req: Request, res: Response, next: NextFunction) => {
  console.log("Login route hit");
  try {
    const { username, password } = req.body.params || req.query || req.body;   // ther

    console.log("Received data: ", { username, password });

    console.log("Logging In!");

    if (!(username && password)) {
      res.status(400).send("All input is required");
    }

    const result = await this.logIn(username, password);

    if (result.success) {
      console.log("logged IN!");
      res.status(200).send(result.data);
    }
    else {
      console.log("Failed to log in!");
      res.status(400).send("Invalid Credentials");
    }

  } catch (err) {
    console.log(err);
    res.status(400).send("Invalid Credentials");
  }
};
```

Front End (Calling the API)

```
login: async (username: string, password: string) => {
  try {
      const url = `${basePath}/auth/login`;
      const params = {
          username: username,
          password: password,
      };

      const response = await axios.post(url, null, { params, withCredentials: true, maxRedirects: 5});

      if (response.status === 200) {
        const user = response.data;
        return { success: true, data: user };
      } else {
        return { success: false, error: "Login failed" };
      }
  } catch (error) {
    return { success: false, error: "Error during login" };
  }
},
```

To Action...

Ready to dive in?