💻 **Backend (Node.js/Express)**

File/Folder	Purpose
server.js	The entry point. It initializes the server and listens on a port.
app.js	Configures Express, attaches global middleware (CORS, JSON), and sets up base route paths.
config/	Contains configuration for external connections (Auth0 keys, Redis/Cache settings, Env vars).
routes/	The "front desk." Maps URL endpoints (like `/api/weather`) to specific controller logic.
middleware/	Security gatekeeper. `auth.middleware.js` verifies the JWT token before allowing access.
services/	The "brain." `weather.service.js` handles logic; `comfortIndex.service.js` does the calculations.
data/cities.json	A static list of cities your app tracks (e.g., London, New York, Tokyo).

▦ **Export to Sheets**

External Services

Cache/Redis

OpenWeatherMap

User

React

Backend

Business Logic

Comfort Index
Logic

User
(Browser)

Weather Analytics System
(Comfort Index Dashboard)

Auth0
Authentication

OpenWeatherMap
Weather API

```
                    ┌─────────────────────────┐
                    │        Browser          │
                    │   React Frontend (SPA)   │
                    └─────────────────────────┘
                                 │
                            HTTPS + JWT
                                 │
                                 ▼
    ┌─────────────────────────────────────────────────────────────┐
    │              Backend API (Node.js /                          │
    │                 ┌─────────────────────────┐                  │
    │                 │    Auth Middleware       │ . . . . . . . . . . . ┐
    │                 └─────────────────────────┘                  │    .
    │                          │                                   │    .
    │                          ▼                                   │    .
    │                 ┌─────────────────────────┐                  │    .
    │                 │    Weather Service       │                 │    .
    │                 └─────────────────────────┘                  │    .
    │                   │                  │                       │    .
    │                   ▼                  ▼                       │    .
    │          ┌──────────────────┐  ┌──────────────┐             │    .
    │          │ Comfort Index    │  │  Cache Layer  │            │    .
    │          │     Logic        │  └──────────────┘            │    .
    │          └──────────────────┘         │                    │    .
    └───────────────────────────────────────┼────────────────────┘    .
                                             │                         ▼
                                             ▼              ┌──────────────────┐
                                  ┌──────────────────┐      │      Auth0        │
                                  │ OpenWeatherMap   │      │    (Identity)     │
                                  │   Weather API    │      └──────────────────┘
                                  └──────────────────┘
```

Backend API

Auth Middleware

JWT validation

Weather Controller

Core Logic

Weather Service
(Read cities, Call API)

Cache Service
(5 min TTL)

Comfort Index Calculation

```
                    ┌─────────┐
                    │  User   │
                    └─────────┘
                         │
                         ▼
                    ┌─────────┐
                    │React App│
                    └─────────┘
                         │
    ┌────────────────────┼──────────────────────┐
    │              MFA Flow│                      │
    │               ┌─────────────┐              │
    │               │ Auth0 Login │              │
    │               └─────────────┘              │
    │                    │                       │
    │                    ▼                       │
    │            ┌─────────────────┐             │
    │            │ Email + Password│             │
    │            └─────────────────┘             │
    │                    │                       │
    │                    ▼                       │
    │                  ◇─────◇                   │
    │                 ╱       ╲                  │
    │                ╱  MFA     ╲                │
    │                ╲ Triggered ╱               │
    │                 ╲         ╱                │
    │                  ◇───────◇                 │
    │                    │                       │
    │                    ▼                       │
    │        ┌───────────────────────┐           │
    │        │ Auth0 sends OTP to Email│          │
    │        └───────────────────────┘           │
    │                    │                       │
    │                    ▼                       │
    │            ┌────────────────┐              │
    │            │ User enters OTP│              │
    │            └────────────────┘              │
    └────────────────────┼──────────────────────┘
                         │
                         ▼
                ┌─────────────────┐
                │ Auth0 issues JWT│
                └─────────────────┘
                         │
                         ▼
                ┌──────────────────┐
                │ React stores token│
                └──────────────────┘
                         │
                         ▼
            ┌──────────────────────────┐
            │ Backend API access granted│
            └──────────────────────────┘
```

React UI

Cache Layer - 5 min TTL

Backend API

Cache Check

MISS

Call OpenWeatherMap

HIT

Store in Cache

Return Cached Data

```
server.js → app.js → weather.routes.js → weather.service.js → comfortIndex.service.js
                                                            → cache.service.js → config/cache.js
                                       → auth.middleware.js → config/auth0.js
```

Developer/Admin

Health Checks

GET /api/debug/status

Cache Connection

AuthO Config

Env Variables

Status Report JSON

```
                          ┌─────────┐
                          │  User   │
                          └─────────┘
                               │
                               ▼
                       ┌─────────────────┐
                       │ React Dashboard │◄──────────────┐
                       └─────────────────┘               │
                               │                         │
              GET /api/weather (JWT)                      │
                               │                          │
      ┌────────────────────────┼──────────────────────────────────┐
      │                        ▼          Backend API Container    │
      │                     ◇◇◇◇◇◇◇                                │
      │                   ◇           ◇                            │
      │                  ◇ Auth Middleware ◇                       │
      │                  ◇  JWT Valid?    ◇                        │
      │                   ◇             ◇                          │
      │                     ◇◇◇◇◇◇◇                                │
      │               ✕ Invalid      ✓ Valid                       │
      │              ┌──────────┐        │                         │
      │              ▼          │        ▼                         │
      │  ┌──────────────────┐   │     ◇◇◇◇◇◇◇                     │
      │  │ 401 Unauthorized │   │   ◇          ◇                   │
      │  └──────────────────┘   │  ◇ Cache Service ◇              │
      │                         │  ◇  5 min TTL   ◇               │
      │                         │   ◇          ◇                   │
      │                         │     ◇◇◇◇◇◇◇                     │
      │                         │         │   MISS                  │
      │                         │         ▼                         │
      │                    HIT  │  ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐ │
      │                         │     Cache MISS Process          │
      │                         │  │ ┌────────────────────┐    │ │
      │                         │    │  Read cities.json  │      │
      │                         │  │ └────────────────────┘    │ │
      │                         │             │                   │
      │                         │  │          ▼                │ │
      │                         │    ┌────────────────────┐      │
      │                         │  │ │ Call OpenWeatherMap│    │ │
      │                         │    └────────────────────┘      │
      │                         │  │          │                │ │
      │                         │             ▼                   │
      │                         │  │ ┌──────────────────────┐  │ │
      │                         │    │ Compute Comfort Index│    │
      │                         │  │ └──────────────────────┘  │ │
      │                         │             │                   │
      │                         │  │          ▼                │ │
      │                         │    ┌──────────────────┐        │
      │                         │  │ │ Sort & Rank Cities│     │ │
      │                         │    └──────────────────┘        │
      │                         │  │          │                │ │
      │                         │             ▼                   │
      │                         │  │ ┌──────────────────┐      │ │
      │                         │    │  Save to Cache   │        │
      │                         │  │ └──────────────────┘      │ │
      │                         │             │                   │
      │                         │  └ ─ ─ ─ ─ ─│─ ─ ─ ─ ─ ─ ─ ┘ │
      │                         │             │                   │
      └─────────────────────────┼─────────────│──────────────────┘
                                │             ▼                   │
                                │     ┌──────────────┐            │
                                └────►│   Response   │────────────┘
                                      └──────────────┘
```

```mermaid
flowchart TD
    User((User))
    User --> ReactLogin[React Login Page]

    subgraph Auth0[Auth0 Authentication]
        EmailPassword[Email + Password]
        MFA{MFA Triggered}
        MFACode[MFA Email Code]
        Verify[Verify & Sign]

        EmailPassword --> MFA
        MFA -->|Required| MFACode
        MFA -->|Optional/Success| Verify
        MFACode --> Verify
    end

    ReactLogin --> EmailPassword
    Verify --> JWT[JWT Token Issued]
    JWT --> Store[React stores token]
    Store --> Backend[Backend APIs allowed]
```

User

React Login Page

Auth0 Authentication

Email + Password

MFA Triggered

Required

MFA Email Code

Optional/Success

Verify & Sign

JWT Token Issued

React stores token

Backend APIs allowed

Left flowchart — Authentication flow:

User

↓

React Login Page

↓

Auth0 Identity Provider

Email + Password

↓

MFA Challenge

- Required → Verify Email OTP Code
- Verified →

Verify Email OTP Code → Sign JWT Token

↓

JWT Token Issued

↓

React stores token
LocalStorage / Cookies

↓

Backend APIs Allowed

Right flowchart — Weather data flow:

User

↓

Dashboard.jsx

↓

api.js

↓ GET /api/weather (Bearer JWT)

Entry & Security

server.js / app.js

↓

weather.routes.js

↓

auth.middleware.js

↓ Valid

Business Logic

weather.service.js

↓

cache.service.js

- HIT
- MISS → Read cities.json

Read cities.json

↓

httpClient.js

↓

OpenWeatherMap API

↓ Raw Data

comfortIndex.service.js

↓

Sort & Rank Cities

↓

Update Cache

↓

JSON Response

(HIT → JSON Response)

```
Developer / Tester
        │
        ▼
Browser / Postman
```

GET /api/debug/cache
(Bearer JWT)

Admin Access
```
server.js / app.js
        │
        ▼
debug.routes.js
        │
        ▼
auth.middleware.js
```

Authorized

System State
```
cache.service.js
        │
        ▼
Query Internal Store
      /        \
     ▼          ▼
Current Status:   Remaining TTL:
HIT / MISS        seconds
```

JSON Debug Response

```
                          ┌─────────────────────┐
                          │  weather.routes.js  │
                          └─────────────────────┘
                                     │
                                     ▼
                          ┌─────────────────────┐
                          │  auth.middleware.js │
                          └─────────────────────┘
                                     │
     ┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─│─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
                        weather.service.js        │
     │                    Orchestration           ▼                  │
                          ┌─────────────────────┐
     │                    │  weather.service.js │                    │
           ┌──────────────└─────────────────────┘──────────────┐
     │     │                    │          │                   │     │
           ▼                    ▼          ▼          Data      ▼
     │ ┌─────────────┐  ┌──────────────────┐  ┌──────────┐  ┌──────────────┐ │
       │cache.service│  │comfortIndex.     │  │httpClient│  │Final Response│
     │ │    .js      │  │  service.js      │  │   .js    │  └──────────────┘ │
       └─────────────┘  └──────────────────┘  └──────────┘
     └ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─│─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
                                                 │
                                                 ▼
                                        ┌───────────────┐
                                        │               │
                                        │ OpenWeatherMap│
                                        │      API      │
                                        │               │
                                        └───────────────┘
```

```
weather.service.js
        │
        ▼
cache.service.js
has 'weatherData'?
```

YES (HIT)

NO (MISS)

Fetch Data + Compute
Comfort Index

Return Cached Result

cache.service.set
'weatherData', 300s TTL

Final Response

User Requests /api/weather

Backend checks 'cache box'

HIT

MISS

Fetch Weather Data

Calculate Comfort Index

Return data immediately

Store result in cache

Response Received