StudyBuddy

Layered Architecture

Presented by - Jaber Ahmed Deedar (**2005023**)
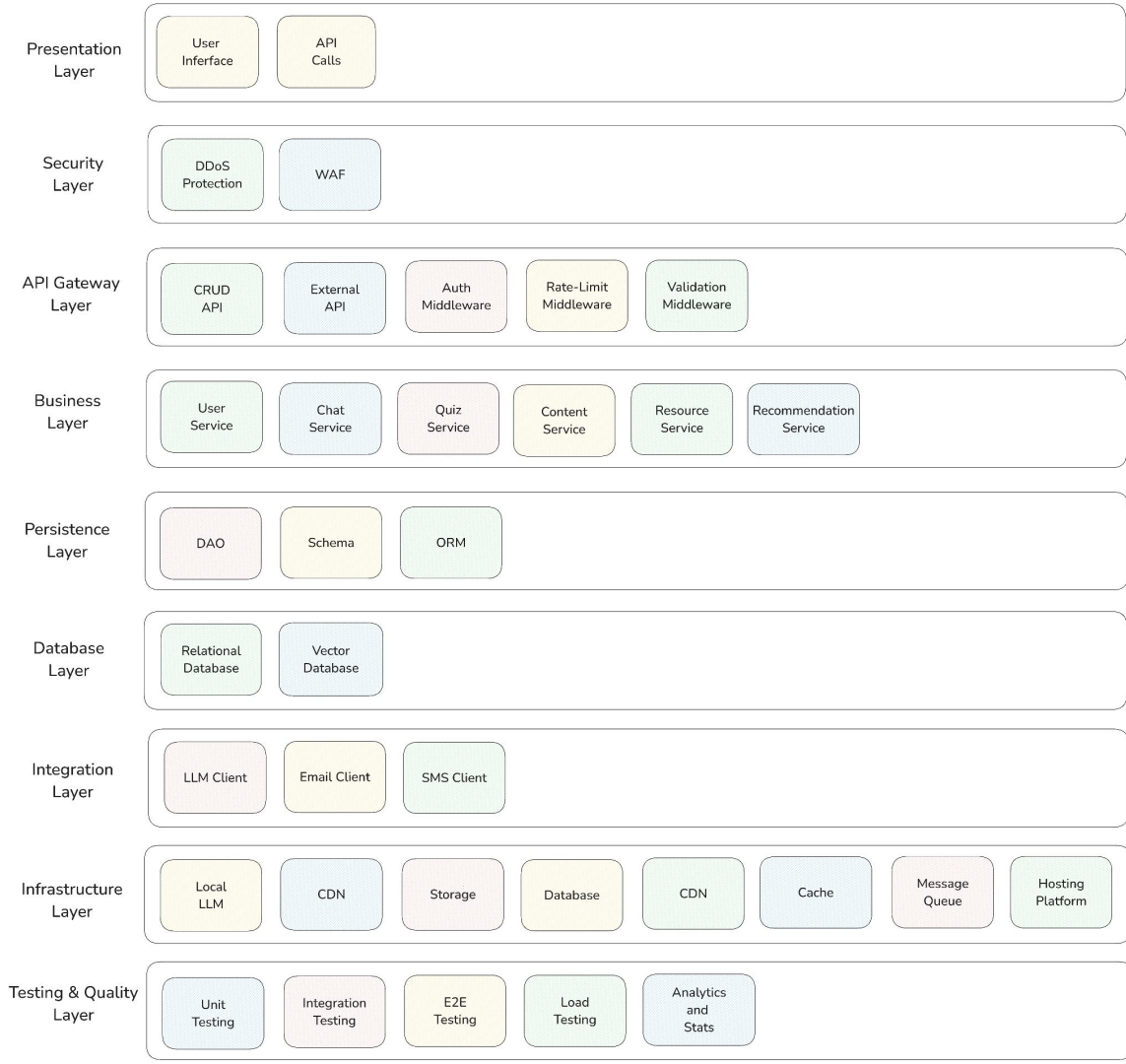
Anik Saha (**2005001**)

Kowshik Saha (**2005006**)

Abrar Jahin Sarkar (**2005012**)

Al Muhit Muhtadi (**2005013**)

Abdullah Muhammed Amimul Ehsan (**2005017**)

Presentation Layer	User Inferface	API Calls			

Security Layer	DDoS Protection	WAF			

API Gateway Layer	CRUD API	External API	Auth Middleware	Rate-Limit Middleware	Validation Middleware

Business Layer	User Service	Chat Service	Quiz Service	Content Service	Resource Service	Recommendation Service

Persistence Layer	DAO	Schema	ORM

Database Layer	Relational Database	Vector Database

Integration Layer	LLM Client	Email Client	SMS Client

Infrastructure Layer	Local LLM	CDN	Storage	Database	CDN	Cache	Message Queue	Hosting Platform

Testing & Quality Layer	Unit Testing	Integration Testing	E2E Testing	Load Testing	Analytics and Stats

1. Presentation Layer

Purpose

- Handles user interaction and the visual representation of data
- Fetches resources from backend based on users' query
- Updates and inserts user provided data in backend
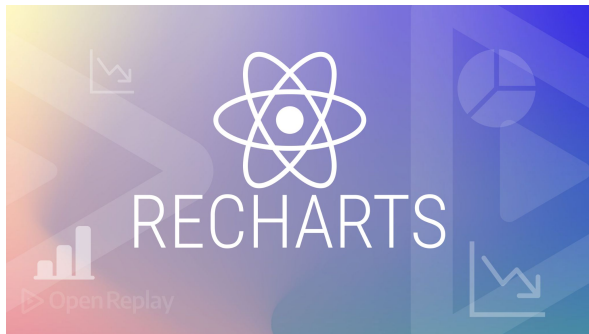
1. Presentation Layer

Components/Services

- User Dashboard
- Chat-bot
- Take Quiz
- View Quiz Result
- Add Resource
- View Resource & Questions
- Moderate Questions

1. Presentation Layer

Tech Stack

- Next.js
- TailwindCSS
- Shadcn/ui
- Jotai
- Recharts

2. Security Layer

Purpose

- Secures the API Gateway layer from malicious requests
- Blocks bots from scrapping and automation
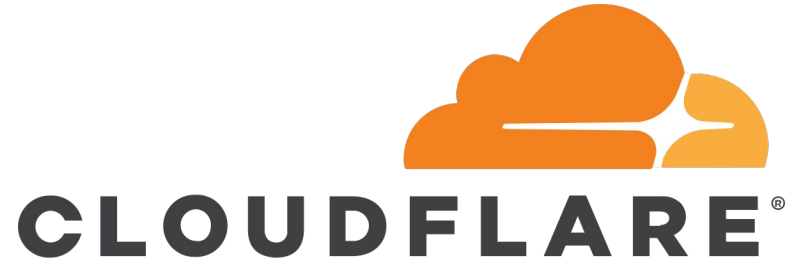- Prevents DDoS, SQLi, XSS, CSRF etc attacks

2. Security Layer

Components/Services

- DDoS Protection
- Web Application Firewall (WAF)

2. Security Layer

Tech Stack

- Cloudflare
- AWS WAF

3. API Gateway Layer

Purpose

- Provides API for the presentation layer to communicate with business layer

- Abstracts interactions with services

- Provides middlewares to preprocess a request

3. API Gateway Layer

Components/Services

- Endpoints
  - API endpoints for CRUD operations
  - APIs for other services and external endpoints
- Middlewares
  - Rate Limit
  - Request Validation
  - Authentication

3. API Gateway Layer

Tech Stack

- ExpressJS with Deno
- FastAPI with Uvicorn

4. Business Logic Layer

Purpose

- Implements the core logic of backend
- Data processing, storing, retrieval workflow

4. Business Logic Layer

Components/Services

- UserService
  - User registration, login, forgot password etc features
  - ProfileService
  - User's progress, generated content, dashboard, taken quizes etc
- ChatService
  - Storing and retrieving chat history
  - Chat response, quiz and content generation

4. Business Logic Layer

Components/Services

- QuizService
  - Fetching quiz questions
  - User's submission evaluation and marks generation with ranking
  - Updating user's progress
- ContentService
  - Content generation and storage
  - Content viewing and sharing

4. Business Logic Layer

Components/Services

- ResourceService
  - Resource uploading and preprocessing (extraction, synthesis etc)
  - Resource moderation
- RecommendationService
  - Generating user preferences
  - Recommending user, questions and popular contents

4. Business Logic Layer

Tech Stack

- Keycloak
- Firebase Auth (for MVP)
- Langchain
- Unstructured
- LLamaParse

5. Persistence Layer

Purpose

- Abstracts interactions with the database
- Provides schemas for database tables

5. Persistence Layer

Components/Services

- Data Access Objects (DAO)
- Schemas
- ORM

5. Persistence Layer

Tech Stack

- Prisma
- SQLAlchemy

6. Database Layer

Purpose

- Actual storage and management of data
- Handles relations between data
- Enables querying data efficiently
- Enables semantic search

6. Database Layer

Components/Services

- Relational database to store structured data
- Vector database to store embeddings

6. Database Layer

Tech Stack

- PostgreSQL
- Qdrant, ChromaDB
- OpenAI Embeddings

7. Integration Layer

Purpose

- Abstracts communication with external APIs
- Enables usage of external services with ease

7. Integration Layer

Components/Services

- LLM Clients
- Email
  - For email verification during registration
  - Also, for 2 factor authentication
- SMS
  - For sending OTP during registration

7. Integration Layer

Tech Stack

- OpenAI
- Gemini
- Claude
- SendGrid
- Twilio

8. Infrastructure Layer

Purpose

- Provides foundational support for hosting and deployment the backend APIs, models and user's data

- Storing temporary data for different services
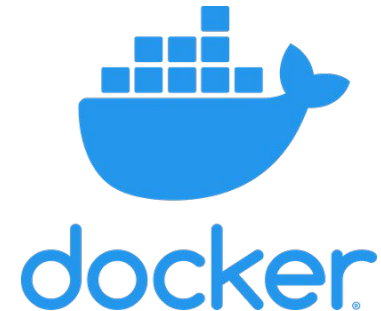
- Storing resources like images, pdf in CDN

8. Infrastructure Layer

Components/Services

- Hosting Platform
    - AWS EC2 (Elastic Compute Cloud)
    - Vercel

- Containerization
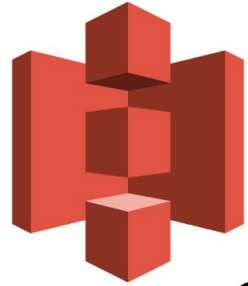   - AWS EKS (Elastic Kubernetes Service)
    - Docker

8. Infrastructure Layer

Components/Services

- Storage
  - S3 (Simple Storage Service)
  - EBS (Elastic Block Service)
- Database
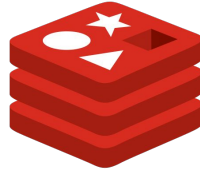 - AWS RDS (Relational Database System
- CDN
  - AWS CloudFront

Amazon S3

Amazon RDS

8. Infrastructure Layer

Components/Services

- Cache
    - Redis (for api request caching)
    - SQLite (for prompt caching)
- Asynchronous Communication & Load Balancing
    - RabbitMQ (for communication between services)
    - Nginx (web server, reverse proxy and load balancer)

8. Infrastructure Layer

Components/Services

- CI/CD Pipeline
  - Github Actions
  - Jenkins
- Deploying Local LLM Models
  - Ollama hosted on AWS EC2

9. Testing and Quality Layer

Purpose

- Ensuring the app is working properly
- Finding bugs and performance issues
- Alert system for critical system faults

9. Testing and Quality Layer

Components/Services

- Unit Tests
- Integration Testing
- E2E Testing
- Load Testing
- Analytics and Stats

9. Testing and Quality Layer

Tech Stack

- Unittest, Jest
- Cypress, Postman
- Selenium, Playwright
- Apache JMeter
- Metabase