ADAPTIVE EDUCATION PLATFORM FOR ENHACED LEARNING

A PROJECT REPORT

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ABSTRACT

In the evolving digital education space, personalized learning platforms are transforming the way individuals prepare for exams, job interviews, coding practice, and more. AdaptIQ is an AI-powered Learning Management System (LMS) that enables users to generate customized study materials tailored to their learning goals. The platform integrates Clerk authentication, allowing users to sign in securely using email or Google login. Upon logging in, users can access a dedicated dashboard where they can create and manage their study resources. The system offers five free credits, allowing users to generate up to five personalized courses at no cost. Once exhausted, additional credits can be purchased via Stripe's secure payment gateway through a subscription model or one-time purchases. The platform is built on Neon PostgreSQL, ensuring efficient data storage and management. Additionally, Inngest functions integrated with Vercel enable real-time event triggers, allowing faster content generation using the Gemini API. Users can track all generated courses within their dashboard, ensuring seamless access and organization of study materials. AdaptIQ leverages AI-driven content creation and optimized database architecture to provide a scalable, interactive, and efficient learning experience. The adaptive nature of the platform ensures that learners receive tailored recommendations based on their progress, engagement, and learning preferences. The integration of real-time data processing and automation enhances the efficiency of study material generation, reducing manual effort and providing a more user-centric approach. With seamless authentication and an intuitive user interface, AdaptIQ aims to make personalized education more accessible and effective. Future enhancements will focus on expanding AI capabilities, deeper customization options, and integrating gamification features to enhance user engagement and motivation. The system will also introduce collaborative learning spaces where users can share knowledge and insights. AdaptIQ envisions an AI-driven education model that continuously evolves to meet diverse learning needs.

Keywords: AI-Powered LMS, Personalized Learning, Study Material Generation, Clerk Authentication, PostgreSQL, Neon Database, Inngest function, Vercel, Stripe Payment Gateway, Gemini API..

TABLE OF CONTENTS

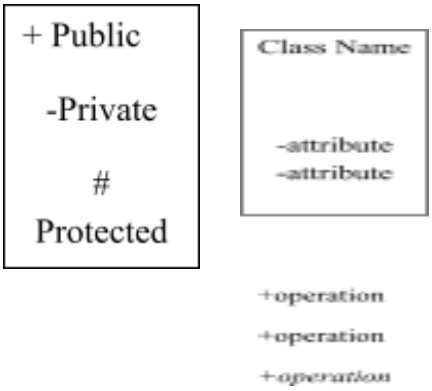
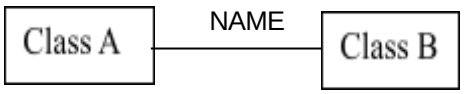
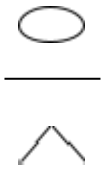
CHAPTER NO	TITLE	PAGE NO
	ABSTRACT	I
	LIST OF FIGURES	IV
	LIST OF SYMBOLS	V
1	**INTRODUCTION**	1
	1.1 OVERVIEW	2
	1.2 OBJECTIVE	2
	1.3 LITERATURE SURVEY	3
2	**SYSTEM ANALYSIS**	5
	2.1 EXISTING SYSTEM	6
	2.1.1 DISADVANTAGES	6
	2.2 PROPOSED SYSTEM	6
	2.2.1 ADVANTAGES	7
3	**SYSTEM REQUIREMENTS**	8
	3.1 HARDWARE REQUIREMENTS	9
	3.2 SOFTWARE REQUIREMENTS	9
	3.3 SOFTWARE DESCRIPTION	10
4	**SYSTEM DESIGN**	17
	4.1 SYSTEM ARCHITECTURE	18
	4.2 UML DIAGRAM	19
	4.2.1 USE CASE DIAGRAM	19
	4.2.2 ACTIVITY DIAGRAM	20
	4.2.3 SEQUENCE DIAGRAM	21

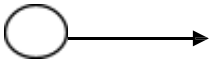
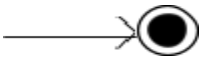
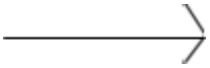
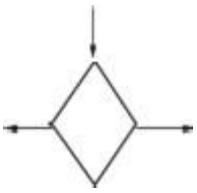
CHAPTER NO	TITLE	PAGE NO
5	**SYSTEM IMPLEMENTATION**	23
	5.1 LIST OF MODULES	24
	5.2 MODULE DESCRIPTION	24
	5.2.1: USER AUTHENTICATION MODULE	24
	5.2.2: COURSE CREATION MODULE	25
	5.2.3: STUDY MATERIAL GENERATION MODULE	26
	5.2.4: CREDIT MANAGEMENT MODULE	26
	5.2.5: DATABASE MANAGEMENT MODULE	26
	5.2.6: ADMINISTRATOR DASHBOARD MODULE	27
6	**TESTING**	28
	6.1 UNIT TESTING	29
	6.2 INTEGRATION TESTING	30
	6.3 USER ACCEPTANSE TESTING	30
7	**RESULTS AND DISCUSION**	31
	7.1 RESULTS	32
	7.2 DISCUSSION	32
8	**CONCLUSION AND FUTURE ENHANCEMENT**	33
	8.1 CONCLUSION	34
	8.2 FUTURE ENHANCEMENTS	34
	ANNEXURE	35
	APPENDIX 1 SAMPLE CODE	36
	APPENDIX 2 OUTPUT SCREENSHOTS	51
	REFERENCES	57

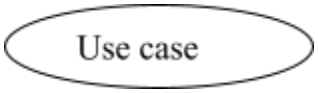
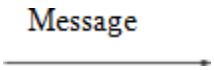
LIST OF FIGURES

FIGURE NO	FIGURE NAME	PAGE NO
4.1	System Architecture for AdaptIQ	18
4.2	Workflow of Study Material Generation	19
4.3	Use case Diagram for AdaptIQ	20
4.4	Activity diagram for Study Material Generation	21
4.5	Sequence Diagram for User Interaction	22

LIST OF SYMBOLS

S.NO	NOTATION NAME	NOTATION	DESCRIPTION
1.	Class		Represents a collection of similar entities grouped together
2.	Association		Associations represents static relationships between classes
			Roles represents the way the two classes see each other
3.	Actor		Specifies a role played by a user that interacts with the subject.

S.NO	NOTATION NAME	NOTATION	DESCRIPTION
4.	Communication		Communication between various use cases.
5.	Initial State		Initial state of the object
6.	Final State		Final state of the object
7.	Control Flow		Represents various control flow between the states.
8.	Decision Box		Represents decision making process from a constraint.

S.NO	NOTATION NAME	NOTATION	DESCRIPTION
9.	Use Case		Interaction between the system and external environment.
10.	Externalenity		Represents external entities such as keyboard , sensors etc.
11.	Transition		Represents communication that occurs between Processes
12.	Object Life Line		Represents the vertical dimensions that the object communicates.
13.	Message		Represents the Messages exchanged

CHAPTER 1

INTRODUCTION

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The rapid advancement of digital education has increased the demand for personalized and adaptive learning solutions. AdaptIQ is an AI-powered Learning Management System (LMS) designed to provide users with customized study materials based on their learning objectives. Whether preparing for exams, job interviews, coding practice, or self-improvement, the platform offers an intelligent and efficient learning experience. The system incorporates Clerk authentication, enabling users to sign in securely using email or Google login. Once authenticated, users gain access to a dedicated dashboard where they can create and manage their study materials effortlessly. The AI-driven content generation process, powered by Gemini API, ensures that users receive high-quality, relevant study materials tailored to their needs. The platform follows a credit-based model, granting each user five free credits to generate up to five study courses at no cost. Once the free credits are exhausted, users can purchase additional credits via Stripe's secure payment gateway through a subscription plan or one-time payment. The backend infrastructure is built on Neon PostgreSQL, ensuring reliable data storage and efficient management. Additionally, Inngest functions integrated with Vercel facilitate real-time event triggers, allowing seamless content generation and improved user experience.

1.2 OBJECTIVE

The objective of AdaptIQ is to create an intelligent learning platform that personalizes study material generation for users preparing for exams, job interviews, and coding practice. It aims to enhance knowledge retention by leveraging AI-driven content recommendations and real-time automation. The system ensures seamless user authentication, efficient course management, and optimized credit-based access while maintaining a scalable and interactive learning experience.

1.3 LITERATURE SURVEY

[1] T. Kabudi, I. Pappas, D. H. Olsen – "AI-Enabled Adaptive Learning Systems: A Systematic Mapping of the Literature" (2021)

This research provides a comprehensive overview of AI techniques employed in adaptive learning systems. It categorizes various AI methodologies used to personalize educational content. The study identifies gaps in current research and suggests areas for future exploration. It emphasizes the need for advanced AI techniques, such as deep learning and natural language processing, in education. It discusses how mobile applications can leverage crowd-sourced data to identify and address waste-related issues such as uncleared garbage bins and illegal dumping.

[2] Muhammad Jawad Mustfa, Sidra Ashiq – "Harnessing the Power of Artificial Intelligence for Adaptive Learning Systems: A Systematic Review" (2024)

This systematic review synthesizes research on adaptive learning based on publication trends and instructional contexts. It analyzes various research methodologies and focuses within the field. The study identifies gaps in the literature and suggests directions for future research. It also discusses the technologies employed in adaptive learning environments**.**

[3] Herva Emilda Sari, Benelekser Tumanggor, David Efron – "Improving Educational Outcomes Through Adaptive Learning Systems Using AI" (2024)

This survey paper explores the development of a Learning Management System integrated with an AI assistant. It discusses innovative features such as document-based and video-based learning modules. The study highlights the role of AI in enhancing the learning process and efficiency for learners. It also examines the integration of comprehensive project guides and career roadmaps within the system.

[4] Phineas Sebopelo – "Adaptive Learning Strategies in Open and Distance eLearning: Opportunities and Challenges for Quality Assurance" (2025)

This study provides an overview of the integration of artificial intelligence into learning management systems. It analyzes a range of documents to identify emerging themes and topics in the field.

The paper discusses the evolution of AI applications in education over a specified period. It also offers directions and recommendations for future research in AI-driven education.

[5] Smith R, Cooper L – "The Role of API Integration in E-Learning Systems" (2020)

This study discusses the impact of API-based integration in modern LMS platforms. It explores how APIs streamline automated content delivery. The research highlights the importance of real-time API event triggers for efficiency. It discusses the role of AI-driven APIs such as Gemini API in LMS platforms. The paper presents a comparative study of API-based learning platforms.

[6] Davis T, Martin J – "AI in Education: Future Perspectives" (2019)

This research explores emerging trends in AI-powered education platforms. It discusses the role of AI in automating assessment and grading. The study highlights the impact of predictive analytics in e-learning. It presents future advancements in AI-driven LMS solutions. The paper evaluates how AI can enhance accessibility in digital education.

[7] Kim D, Park J – "Security and Authentication in Online Learning Platforms" (2021)

This study explores authentication techniques in online educational systems. It highlights the importance of secure login methods such as Clerk authentication. The research discusses data protection measures for safeguarding user information. It evaluates security risks associated with online learning platforms. The study provides recommendations for implementing multi-layer authentication in LMS.

CHAPTER 2

SYSTEM ANALYSIS

CHAPTER 2

SYSTEM ANALYSIS

The system study is to provide the description about the existing system, and proposed system of the project.

2.1 EXISTING SYSTEM

The traditional learning management systems provide static study materials without personalization, making it difficult for learners to receive customized content. Most existing platforms lack AI-driven automation, limiting their ability to dynamically adjust study materials based on user engagement and progress. They do not offer real-time content generation, relying on pre-uploaded materials that may not align with specific learning objectives. Authentication systems in conventional LMS platforms often lack flexibility and security, making user data management inefficient. The absence of a credit-based access model and adaptive recommendations results in a suboptimal learning experience, highlighting the need for an AI-powered solution like AdaptIQ

2.1.1 DISADVANTAGES

- Lacks AI-driven personalized study material generation
- No real-time content adaptation based on user progress.
- Insecure authentication and inefficient user data management.
- Rigid subscription models without flexible credit-based access.
- Limited tracking and recommendation features for learners.

2.2 PROPOSED SYSTEM

The proposed system, AdaptIQ, is an AI-powered learning management platform that generates personalized study materials based on user preferences. It integrates Clerk authentication for secure login using email or Google, ensuring efficient user data management. The platform leverages the Gemini API for AI-driven content generation, dynamically adapting study materials based on user engagement and progress. It employs a credit-based model, allowing users to generate five free courses and purchase additional

credits via Stripe for flexible access. AdaptIQ uses Neon PostgreSQL for scalable database management and Inngest functions with Vercel to enable real-time event triggers, ensuring seamless content creation and optimized learning experiences.

2.2.1 ADVANTAGES

- Generates AI-powered personalized study materials.
- Provides secure authentication using Clerk for user login.
- Adapts study content dynamically based on user engagement.
- Implements a credit-based model for flexible course access.
- Ensures real-time content generation with Inngest and Vercel.
- Uses Neon PostgreSQL for efficient and scalable database management.

CHAPTER 3

SYSTEM REQUIREMENTS

CHAPTER 3
SYSTEM REQUIREMENTS

INTRODUCTION

The development of AdaptIQ requires specific system requirements to ensure smooth functionality and scalability. It integrates AI-driven content generation, secure authentication, and real-time database management. Efficient processing power and reliable storage are essential for handling user data and study material generation. Clerk is used for authentication, ensuring secure login and user management. Neon PostgreSQL is implemented for scalable and efficient database management. Gemini API powers AI-based personalized study material generation.

3.1 HARDWARE REQUIREMENTS

- Operating System: Compatible with Windows, macOS, or Linux distributions.
- Processor: Intel Core i5 or higher for efficient performance.
- RAM: Minimum 8GB RAM (16GB recommended) for smooth performance.
- Storage: At least 256GB SSD for faster data processing.
- Smartphones/Tablets: Compatible devices running Android or iOS operating systems to access the mobile application.
- Graphics: Integrated or dedicated GPU for AI-based processing.
- Server Requirements: Cloud-based hosting with scalable infrastructure.

3.2 SOFTWARE REQUIREMENTS

- Operating System: Windows, macOS, or Linux for development and deployment.
- Programming Languages: JavaScript and java for frontend and backend development.

- Frameworks and Libraries: Next.js, React, TailwindCSS for UI, and Node.js for backend services.
- Database: Neon PostgreSQL for efficient and scalable data management.
- Authentication: Clerk for secure user login and access management.
- AI Integration: Gemini API for AI-powered study material generation.
- Cloud and Hosting: Vercel for frontend deployment and Inngest for real-time event handling.
- Payment Gateway: Stripe for secure credit-based access and subscription management.
- Development Tools: Visual Studio Code and IntelliJ IDEA for coding and debugging.
- Version Control: Git and GitHub for source code management and collaboration.

3.3 SOFTWARE DESCRIPTION

3.3.1 Development Tools

Visual Studio Code: Visual Studio Code is the primary code editor used for frontend and backend development. It provides debugging tools, extensions, and Git integration for efficient development. The lightweight yet powerful editor supports multiple programming languages. Features like IntelliSense and code refactoring improve development speed. It enhances productivity by offering real-time code suggestions and debugging capabilities.

3.3.2 Clerk

Clerk is a secure authentication and user management service integrated into AdaptIQ to handle user login, session management, and access control. It ensures a seamless and secure authentication process while maintaining industry-standard security measures.

- **Multi-Method Authentication:** Supports email-based login and Google OAuth for flexible and secure user authentication.
- **Multi-Factor Authentication (MFA):** Enhances security by requiring additional verification steps beyond a password.
- **Session Management:** Maintains active user sessions with automatic expiration to prevent unauthorized access.
- **Role-Based Access Control (RBAC**): Restricts access based on user roles, such as students and administrators, ensuring data security.
- **Industry-Standard Security Protocols:** Implements OAuth 2.0 and OpenID Connect for encrypted and secure authentication.
- **JWT-Based API Security:** Uses JSON Web Tokens (JWT) to facilitate secure communication between the frontend and backend.
- **Real-Time Activity Monitoring:** Tracks user login attempts, detects suspicious activities, and prevents unauthorized access.
- **Seamless Developer API Integration:** Provides easy-to-use APIs for managing authentication workflows within AdaptIQ.
- **Scalability and Reliability:** Handles authentication requests efficiently, even under high traffic loads**.**
- **Data Encryption and Privacy Compliance**: Ensures user credentials are securely stored and meets global security standards.

3.3.3 Inngest

Inngest is a serverless event-driven function execution tool integrated into AdaptIQ to automate course generation, trigger background tasks, and optimize system performance. It enhances the platform's efficiency by handling asynchronous workflows.

- **Automated Workflow Execution:** Inngest triggers real-time events, such as study material generation, without manual intervention. It enables background task processing, reducing delays in content delivery.
- **Scalability and Performance Optimization:** The serverless architecture ensures automatic scaling, handling multiple tasks simultaneously without impacting performance. It minimizes backend load by processing workflows asynchronously.
- **Error Handling and Reliability:** Inngest includes built-in retry mechanisms for failed tasks, ensuring task completion and system stability. It provides detailed logging and monitoring for debugging and tracking event execution.
- **Seamless Integration with Vercel:** The system is optimized for Vercel, ensuring fast execution and minimal latency. It enhances user experience by processing events efficiently and delivering study materials in real-time.

3.3.4 Gemini API

Gemini API is an AI-powered tool integrated into AdaptIQ for generating personalized study materials and enhancing adaptive learning experiences. It uses advanced machine learning techniques to deliver high-quality educational content.

- **AI-Driven Content Generation:** Uses natural language processing (NLP) and deep learning models to create structured, relevant study materials. It adapts content dynamically based on user engagement and learning history.
- **Personalized Learning Experience:** Analyzes user progress to tailor study materials to individual needs. It improves knowledge retention by providing context-aware explanations and recommendations.
- **Real-Time Adaptation:** Continuously updates and refines study content based on user interactions. It ensures that learners receive the most relevant and updated information.

- **Multimodal Learning Support:** Enhances study materials with text, images, and interactive elements. It ensures accessibility by supporting voice-based queries and AI-driven responses.

3.3.5 Neon PostgreSQL

Neon PostgreSQL is a cloud-native, scalable database solution used in AdaptIQ for secure and efficient data management. It ensures high availability and optimized query performance.

- **Cloud-Native Scalability:** Provides dynamic resource allocation, handling high user loads efficiently. It supports read replicas and partitioning to distribute database load.
- **High-Performance Query Execution:** Uses indexing and caching strategies to optimize data retrieval speed. It supports real-time analytics and complex queries for personalized study materials.
- **Data Security & Integrity:** Ensures ACID compliance for transaction reliability and data consistency. Role-based access control (RBAC) restricts unauthorized modifications and protects sensitive data.
- **Seamless Integration with Backend:** Works with Node.js and GraphQL for efficient API interactions. It enables structured storage of user data, course content, and payment transactions.

3.3.6 Stripe

Stripe is a secure and flexible payment gateway used in AdaptIQ to handle credit-based access and subscription management for study materials. It ensures encrypted and seamless financial transactions.

- **Secure Payment Processing:** Supports PCI DSS-compliant transactions, ensuring data encryption and fraud prevention. It enables multi-currency payments and real-time financial reporting.
- **Subscription & Credit-Based Access:** Allows users to purchase additional course credits or opt for subscription plans. Webhooks trigger real-time updates for billing and account status.

- **Automated Invoicing & Tax Calculation:** Generates invoices and applies tax rules based on regional regulations. It simplifies financial management for users and administrators.
- **AI-Driven Fraud Detection:** Uses machine learning models to analyze transaction patterns and prevent fraudulent activities. It minimizes chargebacks and unauthorized payment attempts.

3.3.7 Node.js

Node.js is the backend runtime environment for AdaptIQ, enabling high-performance server-side execution and efficient API handling. It ensures seamless communication between the frontend and database.

- **Asynchronous & Non-Blocking Architecture:** Handles multiple concurrent requests efficiently without performance bottlenecks. It improves application responsiveness and scalability.
- **RESTful API & GraphQL Integration:** Enables structured data retrieval and efficient API communication. It optimizes query execution and reduces redundant data transfers.
- **WebSockets for Real-Time Updates:** Supports bi-directional communication for instant study material updates. It enhances user experience by delivering dynamic content.
- **Memory Management & Security:** Implements garbage collection and request throttling to prevent resource overuse. Security features include JWT-based authentication and API rate limiting.

3.3.8 Next.js & React

Next.js and React are the core technologies used for the frontend development of AdaptIQ, ensuring a responsive and user-friendly learning platform. They enhance performance, navigation, and UI interactivity.

- **Server-Side Rendering (SSR) & Static Site Generation (SSG):** Improves page load speed and SEO optimization. It enhances the application's scalability and content delivery performance.

- **Component-Based UI Development:** Ensures modular, reusable, and maintainable frontend design. React's virtual DOM optimizes rendering efficiency, reducing unnecessary updates.
- **State Management & Context API:** Uses Redux and Context API for efficient data handling. It ensures seamless synchronization between study materials and user progress.
- **Responsive & Mobile-Friendly UI:** TailwindCSS provides a lightweight styling framework for a flexible and adaptive user experience. It ensures accessibility across multiple devices and screen sizes.

3.3.9 Postman

Postman is a powerful API testing and development tool used in AdaptIQ for debugging and ensuring seamless communication between frontend and backend services.

- **API Request Testing & Debugging:** Enables developers to validate API endpoints and analyze response data. It ensures the accuracy and reliability of API interactions.
- **Automated API Testing & Monitoring:** Supports pre-scripted test cases and continuous monitoring of API performance. It prevents unexpected failures and system disruptions.
- **Authentication & Security Testing:** Verifies token-based authentication (JWT, OAuth 2.0) for secure API requests. It ensures compliance with best security practices.
- **Performance Benchmarking & Load Testing:** Simulates concurrent requests to analyze API scalability. It helps identify bottlenecks and optimize backend performance.

3.310 Vercel

Vercel is the cloud-based hosting and deployment platform used for AdaptIQ's frontend, ensuring high-performance and auto-scaling capabilities. It optimizes application speed and reliability.

- **Automated Deployment & CI/CD Integration:** Supports seamless version control and rollback options. It integrates with GitHub for continuous development and instant updates.
- **Edge Computing & Global CDN:** Reduces latency by caching content at edge locations. It ensures fast loading speeds and smooth user interactions.
- **Serverless Function Execution:** Enables backend processes like authentication and study material retrieval. It reduces infrastructure management efforts while ensuring system efficiency.
- **Performance Monitoring & Analytics:** Provides real-time insights into user engagement, resource usage, and application uptime. It helps optimize study material delivery based on traffic patterns.

CHAPTER 4

SYSTEM DESIGN

CHAPTER 4
SYSTEM DESIGN

System design is the process of planning a new system or to replace the existing system. Simply, system design is like the blueprint for building, it specifies all the features that are to be in the finished product.

4.1 SYSTEM ARCHITECTURE

System architecture is the conceptual model that defines the structure, behavior and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system

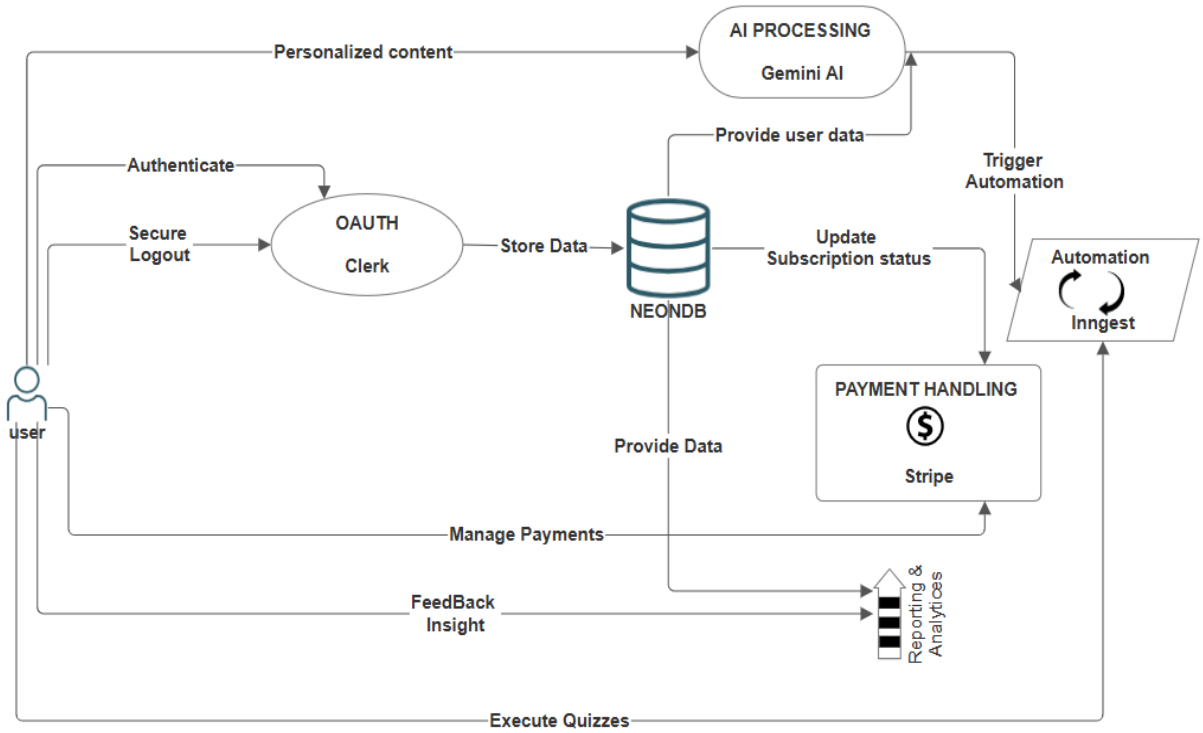


Fig 4.1 Architecture Diagram

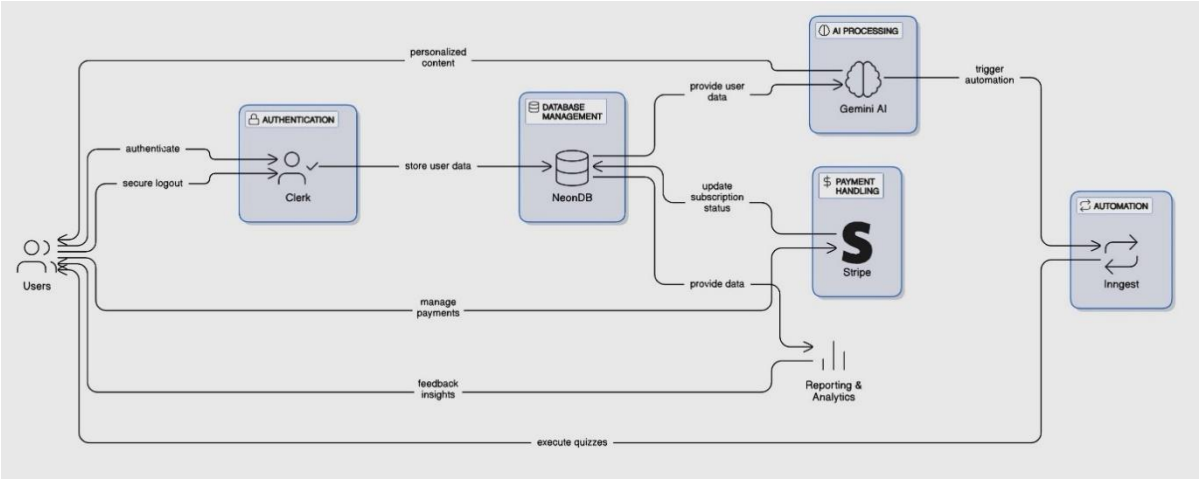


Fig 4.2 Working process of the AdaptIQ

4.2 UML DIAGRAM

4.2.1 USE CASE DIAGRAM

The Use Case Diagram includes the User, Clerk (Authentication), NeonDB (Database), Gemini AI (AI Processing), Stripe (Payment Handling), Inngest (Automation), and Reporting & Analytics. The User can authenticate via Clerk, which stores data in NeonDB, and manage payments through Stripe, which updates the subscription status. Gemini AI fetches user data from NeonDB for personalized recommendations and triggers automation via Inngest. Inngest executes workflows, while Reporting & Analytics provides insights to users. The system ensures secure authentication, data management, AI-powered content, automation, and financial transactions.

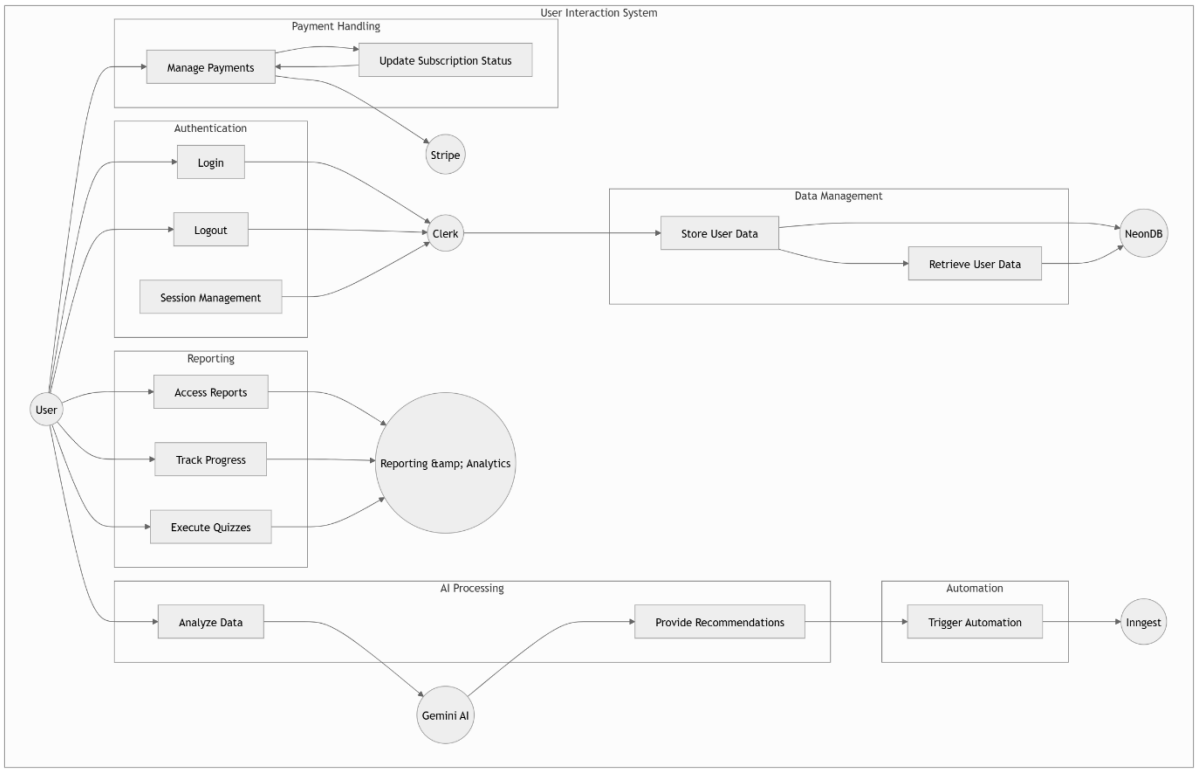


Figure 4.3 Use Case Diagram for AdaptIQ

4.2.2 ACTIVITY DIAGRAM

The activity diagram begins with the user logging in via Clerk, which verifies authentication. Upon successful login, NeonDB stores user data and provides it for AI processing, payments, and automation. Gemini AI processes user data to generate personalized content, while Stripe handles subscription updates. Inngest triggers automation tasks based on AI recommendations or payment updates. The system ensures a seamless flow between authentication, data storage, AI processing, payment handling, and automation.

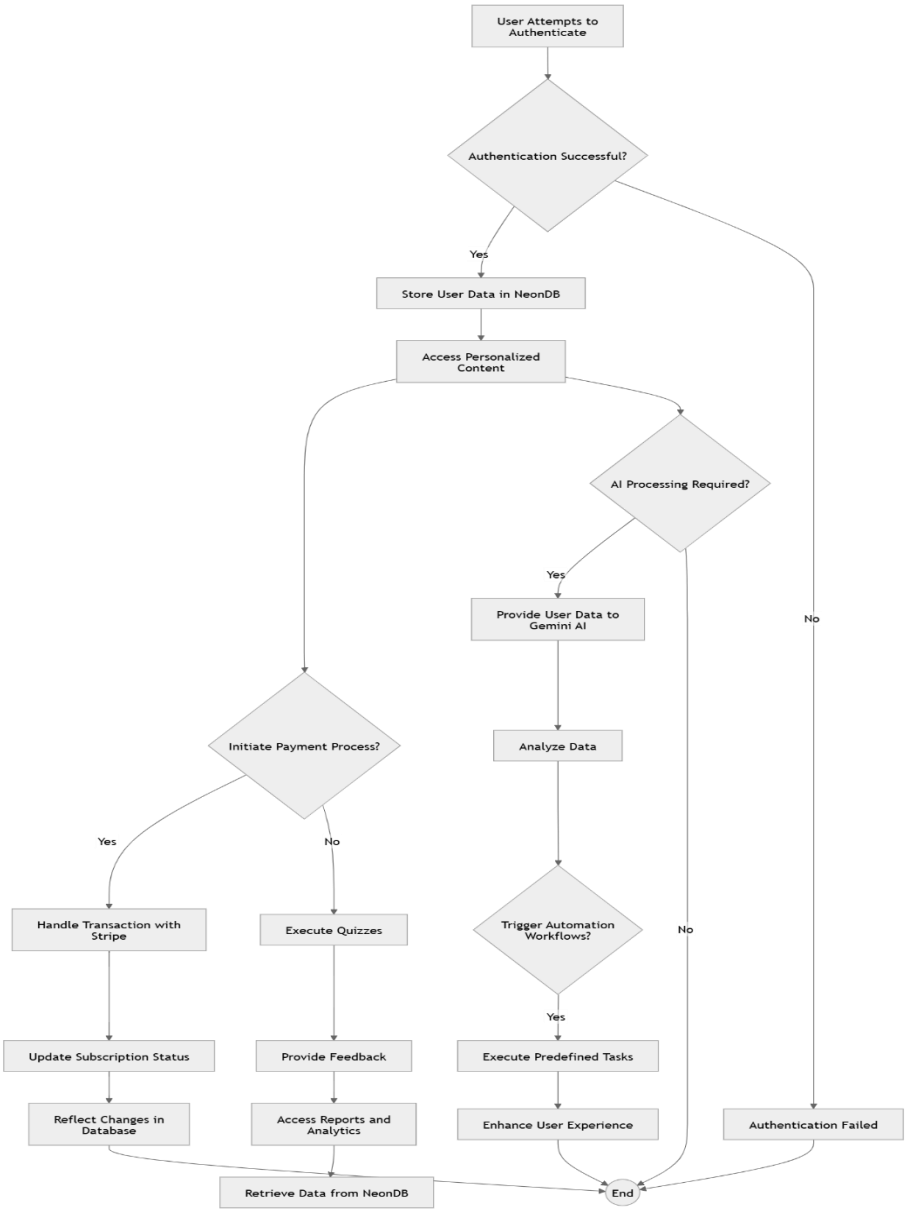


Figure 4.4 Activity Diagram for AdaptIQ

4.2.3 SEQUENCE DIAGRAM

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

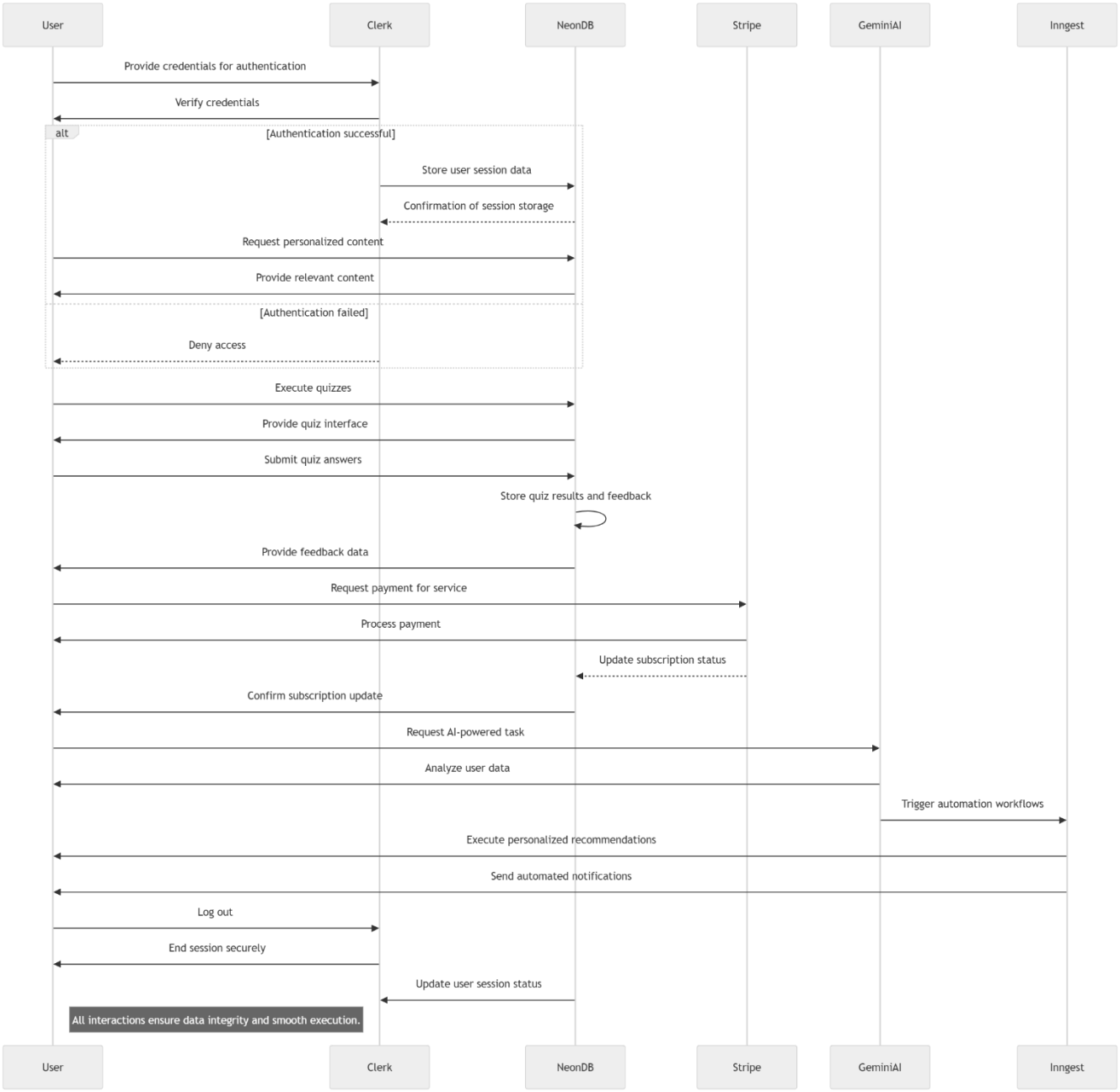


Figure 4.5 Sequence Diagram for AdaptIQ

CHAPTER 5

SYSTEM IMPLEMENTATION

CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 LIST OF MODULES

1. User Authentication Module
2. Course Creation Module
3. Study Material Generation Module
4. Credit Management Module
5. Database Management Module
6. Administrator Dashboard Module

5.2 MODULE DESCRIPTION

5.2.1 : User Authentication Module:

The user authentication module ensures secure access to the platform by handling user registration, login, and session management. It uses Clerk for authentication, enabling users to sign in via email or Google authentication. This module verifies user credentials, preventing unauthorized access and ensuring data privacy. When a user logs in, Clerk generates a secure session token that is validated for each request. If authentication fails, the system prompts the user to retry or reset their password. The module enforces multi-factor authentication (MFA) for additional security, ensuring that sensitive data is well protected. It also manages user roles and permissions, restricting access to different features based on authorization levels. Logged-in users can access study materials, track progress, and manage subscriptions securely. Session expiration policies are implemented to automatically log out inactive users. The module integrates with NeonDB to store user profile data and authentication logs. Failed login attempts trigger security measures such as temporary account lockouts. Passwords are stored securely using encryption techniques, following industry security standards. OAuth 2.0 and JWT (JSON Web Tokens) are used for secure API authentication.

Logout functionality ensures session data is cleared, preventing unauthorized access on shared devices. The authentication module enhances platform security while providing a seamless user experience

Documentation Components:

- **User registration and login flow** – Describes how users sign up, log in, and manage authentication.
- **Session management** – Details how user sessions are handled, including expiration policies and token validation.
- **Security mechanisms** – Covers encryption, OAuth 2.0, JWT usage, and MFA implementation.
- **Error handling and recovery** – Explains how failed login attempts, password resets, and account lockouts are managed.

5.2.2 : Course Creation Module

The course creation module enables users to generate customized courses based on their learning preferences. Users can specify course details such as title, subject, difficulty level, and objectives. The system provides an intuitive interface for defining course structure, including modules, topics, and study materials. AI-driven automation powered by Gemini API helps in generating relevant course content dynamically. The module allows users to select predefined templates or create courses from scratch. Once a course is created, it is stored in NeonDB for easy retrieval and management. Users can modify course content, update study materials, and track progress in real time. The system ensures that all course data is well-organized and accessible via the administrator dashboard. The module also includes an auto-save feature to prevent data loss during the creation process. AI-generated content is personalized based on user input, making learning more efficient. Inngest

automation triggers workflows to enhance course structuring and assignment generation. Role-based access ensures that only authorized users can create and modify courses. The module integrates with the study material generation module to provide comprehensive resources. Users receive notifications when course creation is complete and ready for access. The course creation module streamlines content development, ensuring a smooth and interactive learning experience.

Documentation Components:

- **Course setup process** – Explains how users define course details, structure, and objectives.
- **AI-powered content generation** – Describes how Gemini API personalizes study materials and course topics.
- **Database integration** – Covers how course data is stored, retrieved, and modified in NeonDB.
- **Workflow automation** – Details how Inngest triggers tasks such as course updates and notifications.

5.2.3 : Study Material Generation Module

The study material generation module creates personalized learning resources based on user preferences and course requirements. It utilizes Gemini API to generate high-quality study materials, including text-based content, quizzes, and reference materials. Users can input topics, difficulty levels, and specific requirements to customize the generated content. AI-driven recommendations ensure that the materials align with the user's learning goals and progress. The module integrates with the course creation module to automatically attach relevant study materials to newly created courses.

Users can edit, refine, and add supplementary resources to enhance their study experience. The system supports multiple formats, including text documents, PDFs, and interactive elements. All generated study materials are securely stored in NeonDB for easy access and future reference. Inngest automation helps in updating and refining content dynamically based on user engagement. Users receive notifications when new or updated study materials are available. The module includes plagiarism detection to ensure originality in AI-generated content. Real-time content adaptation ensures that users receive updated information based on the latest trends and syllabus changes. It provides a seamless integration with reporting and analytics to track user engagement. Users can request AI-powered explanations and summaries for complex topics. The study material generation module enhances the learning experience by delivering adaptive and high-quality educational content.

Documentation Components:

- **AI-powered content creation** – Details how Gemini API generates study materials dynamically.
- **Customization and personalization –** Explain how users can tailor content to their specific learning needs**.**
- **Database storage and retrieval** – Describes how generated study materials are stored in NeonDB.
- **Automation and updates –** Cover how Inngest triggers content updates and refinement processes.

5.2.4 : Credit Management Module

The credit management module controls user access to study material generation based on a credit-based system. Each user is allocated a fixed number of free credits upon registration, allowing them to generate study materials or courses. Once the free credits are exhausted, users must purchase additional credits through Stripe's payment gateway. The module ensures seamless integration with the payment system, securely processing transactions and updating credit balances. Credits are deducted each time a user generates a new study material or creates a course. The system provides a transparent credit tracking interface, allowing users to monitor their remaining credits and usage history. Automated email and in-app notifications alert users when they are running low on credits. Subscription plans are also available, allowing users to receive monthly credits instead of one-time purchases. The module integrates with NeonDB to store transaction details, ensuring secure and accurate credit management. Refund and credit adjustment mechanisms are in place for failed transactions or system errors. Role-based access ensures that only users with sufficient credits can generate content. Users can apply promo codes or discounts, which are validated and processed within the module. Inngest automation helps update user balances and trigger notifications in real time. A credit expiration system is implemented to encourage timely usage. The credit management module provides a structured and flexible approach to resource allocation.

Documentation Components:

- **Credit allocation and usage –** Details how users earn and spend credits on study material generation.
- **Payment integration –** Explains how Stripe handles credit purchases and updates balances.

- **Transaction tracking and security –** Covers how credit balances are stored and managed in NeonDB.
- **Automation and notifications –** Describe how Inngest triggers alerts for low credits and purchases.

5.2.5 : Database Management Module:

The database management module is responsible for handling and storing user data, study materials, course details, and transaction records securely. It utilizes NeonDB, a cloud-native PostgreSQL database, to ensure high performance and scalability. The system maintains structured data storage, allowing quick retrieval of user profiles, course progress, and payment history. Data encryption and role-based access control enhance security, preventing unauthorized access to sensitive information. Automated backups are scheduled to protect against data loss and ensure reliability. The module integrates with AI-powered analytics to generate insights based on stored data. Indexing and query optimization techniques improve search efficiency and reduce response times.

Documentation Components:

- **Data storage and retrieval –** Explains how NeonDB organizes and stores user-related data.
- **Security and encryption –** Cover authentication, access control, and encryption techniques.
- **Performance optimization –** Details indexing, query optimization, and real-time data updates.
- **Backup and maintenance –** Describe automated backups, consistency checks, and database monitoring.

5.2.6 : Administrator Dashboard Module:

The administrator dashboard module provides a centralized interface for managing platform operations, monitoring user activity, and handling system configurations. It allows administrators to oversee authentication logs, user course enrollments, and study material usage. The dashboard provides real-time statistics on credit consumption, payment transactions, and AI-generated content. Admins can manage user roles, granting or restricting access to different features. The module includes reporting tools for generating insights on course engagement and learner progress. Integrated with NeonDB, the dashboard retrieves and displays key metrics securely. Role-based access ensures that only authorized personnel can modify critical system settings. Inngest automation helps process bulk updates, such as managing expired subscriptions or resetting user credits.

Documentation Components:

- **User and system monitoring –** Describes how administrators track user activities and system performance.
- **Role-based access and permissions** – Explains how different admin roles manage system configurations.
- **Reporting and analytics –** Cover how data is visualized, exported, and used for decision-making.
- **Automation and alerts –** Details how Inngest triggers notifications for system events and critical updates.

CHAPTER 6

TESTING

CHAPTER 6

TESTING

SYSTEM TESTING AND IMPLEMENTATION

Testing is the process of executing a program or application with the intent of finding software bugs, and to verify that the software product is fit for use.

6.1 UNIT TESTING

Unit testing focuses verification efforts on the smallest unit of software design in the module. This is also known as module testing. The module of the system is tested separately.

MODEL TRAINING AND DEVELOPMENT:

Tokenization and Study Material Generation Test:

Input: Sample user input for study material creation.

Expected Output: Tokenized and structured study content.

Results: Verified the correctness of tokenization and content structuring processes.

AI Model Architecture Test:

Input: AI model parameters for personalized study material generation.

Expected Output: Compiled AI model with specified layers and configurations.

Results: Ensured that the model architecture matches the expected learning structure.

AI Model Training Test:

Input: Training data, epochs, batch size for AI-based study material generation.

Expected Output: Trained AI model capable of generating personalized content.

Results: Checked loss and accuracy metrics during AI model training to ensure efficiency.

APPLICATION DEVELOPMENT:

Course Generation Test:

Input: User input, AI model, tokenized data.

Expected Output: Generated personalized course content.

Results: Validated the accuracy of AI-generated study material.

6.2 INTEGRATION TESTING

Integration testing (sometimes called integration and testing, abbreviated I&T) is the phase in software testing in which individual software modules are combined and tested as a group. It occurs after unit testing and before verification testing. Integration testing takes as its input modules that have been unit tested, groups them in larger aggregates, applies and tests.

Web Application Integration:

Input: Simulated user interactions through the web application interface.

Expected Output: Proper routing study material retrieval, and response generation from the backend.

Results: Ensured seamless integration between the frontend and backend components.

Study Material Generation Functionality Test:

Input: User-generated course request.

Expected Output: AI-generated study material tailored to the user's learning needs.

Results: Verified the accuracy of study material generation based on user input

6.3 USER ACCEPTANCE TESTING

Scenario-Based Testing:

Scenarios: User authentication, course creation, study material generation, credit management, administrator dashboard access.

Expected Outcome: Successful authentication, accurate course creation, proper credit deduction, and dashboard functionality.

Results: Validated the overall functionality and user experience of the learning management system.

CHAPTER 7

RESULTS AND DISCUSIION

CHAPTER 7

RESULTS AND DISCUSSION

7.1 RESULTS

The implementation of the AdaptIQ system successfully enables AI-driven personalized study material generation, efficient course creation, and seamless credit management. The authentication module ensures secure access, allowing users to log in using Clerk, while NeonDB efficiently manages data storage. AI-generated content powered by Gemini API dynamically adapts to user needs, providing an interactive learning experience. Payment handling through Stripe enables smooth transactions for credit-based access, ensuring flexible subscription management. The integration of Inngest for automation enhances workflow efficiency, reducing manual intervention. Reporting and analytics provide valuable insights into user engagement and learning patterns. The administrator dashboard enables real-time monitoring and system management, ensuring smooth operations. Overall, the system delivers a robust, scalable, and efficient e-learning platform tailored to individual learning needs.

7.2 DISCUSSION

Our project aims to revolutionize the e-learning experience by providing AI-driven personalized study materials, automated course creation, and an efficient credit-based access system. Through our web-based platform, we offer a seamless and intuitive user interface accessible to students, professionals, and educators. The process begins with users registering using their email or Google authentication through Clerk, ensuring a secure and streamlined login process. Once authenticated, users are directed to their personalized dashboard, where they can create courses and generate study materials tailored to their learning needs. When generating study materials, users specify their topic, difficulty level, and learning objectives. The request is processed by the AI-driven study material generation module, which utilizes the Gemini API to create structured, high-quality content. This AI-generated material is stored in NeonDB, ensuring that users can access and review their content anytime. Users are given five free credits upon registration, allowing them to generate study materials at no cost. Once these credits are exhausted, they can purchase additional credits through Stripe’s secure payment gateway. The credit management system ensures smooth tracking of user balances and transactions while providing flexible subscription options.

In addition to personalized content, the platform automates various tasks using Inngest, which triggers workflows such as study material refinement and course organization based on user interactions. The administrator dashboard provides an overview of user activity, course progress, and financial transactions, allowing real-time monitoring and management. While our project has successfully implemented AI-driven learning, it currently faces challenges such as refining AI-generated content for niche subjects and optimizing real-time automation. Future updates will focus on enhancing content quality, expanding customization options, and integrating additional learning tools to further improve user engagement and experience.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

CHAPTER 8
CONCLUSION AND FUTURE ENHANCEMENT

8.1 CONCLUSION

The AdaptIQ platform presents an innovative solution for personalized and AI-driven e-learning by seamlessly integrating authentication, study material generation, credit management, and automated workflows. Despite facing challenges in refining AI-generated content for niche subjects and optimizing real-time automation, the platform successfully enhances the learning experience by providing dynamic and structured study materials tailored to user needs. The integration of Gemini AI for content generation, Clerk for authentication, Stripe for credit-based access, and Inngest for workflow automation ensures an efficient and scalable system. Future updates will focus on addressing existing limitations, improving AI-driven content customization, and enhancing automation for better course management. Overall, this project highlights the transformative role of AI and automation in modern education, making learning more accessible, interactive, and adaptive to individual users.

8.2 FUTURE ENHANCEMENTS

In the future, several enhancements could be implemented to further improve the AdaptIQ learning platform. One key enhancement involves refining AI-driven content generation by incorporating advanced natural language processing techniques to ensure higher accuracy and contextual relevance in study materials. Additionally, integrating real-time AI tutoring assistance could provide users with instant support and explanations, making learning more interactive. Expanding the credit management system to include gamification elements, such as reward-based learning incentives, could further engage users and encourage continued platform usage. Moreover, implementing collaborative learning features, such as peer-to-peer discussions and group study sessions, would enhance user engagement and foster a more interactive learning environment.

ANNEXURE

ANNEXURE
APPENDIX I

CODE

Nextjs SAAS Application code:

app/(auth)/sign-in/[[...sign-in]]

```
import { SignIn } from '@clerk/nextjs'

export default function Page() {
  return (
  <div className='flex items-center justify-center h-screen'>
    <SignIn />
  </div>
)
}
```

app/(auth)/sign-up/[[...sign-up]]/page.jsx

```
import { SignUp } from '@clerk/nextjs'

export default function Page() {
  return <SignUp />
}
```

app/api/courses/route.js

```
import { db } from "@/configs/db";
import { STUDY_MATERIAL_TABLE } from "@/configs/schema";
import { desc, eq } from "drizzle-orm";
import { NextResponse } from "next/server";

export async function POST(req) {

   const {createdBy}=await req.json();
```

```
const result=await db.select().from(STUDY_MATERIAL_TABLE)
.where(eq(STUDY_MATERIAL_TABLE.createdBy,createdBy))
.orderBy(desc(STUDY_MATERIAL_TABLE.id))

return NextResponse.json({result:result});
}
export async function GET(req) {
const reqUrl=req.url;
const {searchParams}=new URL(reqUrl);
const courseId=searchParams?.get('courseId');
const course=await db.select().from(STUDY_MATERIAL_TABLE)
.where(eq(STUDY_MATERIAL_TABLE?.courseId,courseId));
return NextResponse.json({result:course[0]})

}
```

app/api/generate-course-outline/route.js

```
import { courseOutlineAIModel } from "@/configs/AiModel";
import { db } from "@/configs/db";
import { STUDY_MATERIAL_TABLE } from "@/configs/schema";
import { inngest } from "@/inngest/client";
import { NextResponse } from "next/server";

export async function POST(req) {

   const {courseId,topic,courseType,difficultyLevel,createdBy}=await req.json();

   const PROMPT='Generate a study material for '+topic+' and
'+courseType+' and level of difficulty  will be '+difficultyLevel+' with
summary of course, List of Chapters (Max 3) along with summary and Emoji
icon for each chapter, Topic list in each chapter, and all result in  JSON
format'
   // Generate Course Layout using AI
   const aiResp=await courseOutlineAIModel.sendMessage(PROMPT);
   const aiResult= JSON.parse(aiResp.response.text());

   // Save the result along with User Input
   const dbResult=await db.insert(STUDY_MATERIAL_TABLE).values({
      courseId:courseId,
      courseType:courseType,
```

```
        createdBy:createdBy,
    topic:topic,
    courseLayout:aiResult
}).returning({resp:STUDY_MATERIAL_TABLE})

//Trigger the Inngest function to generate chapter notes

inngest.send({
    name:'notes.generate',
    data:{
        course:dbResult[0].resp
    }
});
//console.log(result);

return NextResponse.json({result:dbResult[0]})

}
```

app/api/inngest/route.js

```
import { serve } from "inngest/next";
import { inngest } from "../../../inngest/client";
import { CreateNewUser, GenerateNotes, GenerateStudyTypeContent,
helloWorld } from "@/inngest/functions";
export const runtime = 'edge';
// Create an API that serves zero functions
export const { GET, POST, PUT } = serve({
  client: inngest,
  streaming:'allow',
  functions: [
    /* your functions will be passed here later! */
    helloWorld,
    CreateNewUser,
    GenerateNotes,
    GenerateStudyTypeContent
  ],
});
```

app/api/payment/checkout/route.jsx

```
import { NextResponse } from "next/server";
import Stripe from "stripe";

export async function POST(req) {
   const stripe=new Stripe(process.env.STRIPE_SECRETE_KEY);

   const {priceId}=await req.json();

   const session = await stripe.checkout.sessions.create({
      mode: 'subscription',
      line_items: [
        {
          price: priceId,
          // For metered billing, do not pass quantity
          quantity: 1,
        },
      ],
      // {CHECKOUT_SESSION_ID} is a string literal; do not change it!
      // the actual Session ID is returned in the query parameter when your
customer
      // is redirected to the success page.
      success_url: process.env.HOST_URL+'payment-
success?session_id={CHECKOUT_SESSION_ID}',
      cancel_url: process.env.HOST_URL,
    });

   return NextResponse.json(session)

}
```

app/api/payment/manage-payment/route.jsx

```
import { NextResponse } from "next/server";
import Stripe from "stripe";

export async function POST(req) {
   const stripe=new Stripe(process.env.STRIPE_SECRETE_KEY);


const returnUrl =process.env.HOST_URL;
const {customerId} = await req.json();

const portalSession = await stripe.billingPortal.sessions.create({
  customer: customerId,
  return_url: returnUrl,
});

return NextResponse.json(portalSession)

}
```

app/api/payment/webhook/route.jsx

```
import Image from 'next/image'
import React, { useState } from 'react'

function SelectOption({selectedStudyType}) {
   const Options=[
      {
         name:'Exam',
         icon:'/exam_1.png'
      },
      {
         name:'Job Interview',
         icon:'/job.png'
      },
      {
         name:'Practice',
         icon:'/practice.png'
      },
```

```
{
          name:'Coding Prep',
          icon:'/code.png'
       },
       {
          name:'Other',
          icon:'/knowledge.png'
       },

    ]
    const [selectedOption,setSelectedOption]=useState();
  return (
    <div >
       <h2 className='text-center mb-2 text-lg'>For Which you want to create
your personal study material?</h2>
       <div className='grid grid-cols-2 mt-5 md:grid-cols-3 lg:grid-cols-5 gap-
5'>
          {Options.map((option,index)=>(
             <div key={index}
             className={`p-4 flex flex-col items-center justify-center
             border rounded-xl hover:border-primary cursor-pointer
             ${option?.name==selectedOption&&'border-primary'}`}

onClick={()=>{setSelectedOption(option.name);selectedStudyType(option.nam
e)}}
             >
                <Image src={option.icon} alt={option.name} width={50}
height={50} />
                <h2 className='text-sm mt-2'>{option.name}</h2>
             </div>
          ))}
       </div>
    </div>
  )
}

 export default SelectOption
```

```
import { Textarea } from '@/components/ui/textarea'
import React from 'react'
import {
   Select,
   SelectContent,
   SelectItem,
   SelectTrigger,
   SelectValue,
  }
```

Code for dashboard:

```
"use client"
import React, { useState } from 'react'
import SideBar from './_components/SideBar'
import DashboardHeader from './_components/DashboardHeader'
import { CourseCountContext } from '../_context/CourseCountContext'

function DashboardLayout({children}) {
   const [totalCourse,setTotalCourse]=useState(0);
  return (
    <CourseCountContext.Provider value={{totalCourse,setTotalCourse}}>
    <div>
       <div className='md:w-64 hidden md:block fixed'>
          <SideBar/>
       </div>
       <div className='md:ml-64'>
          <DashboardHeader/>
          <div className='p-10'>
             {children}
          </div>
       </div>
       </div>
     </CourseCountContext.Provider>
  )
}

export default DashboardLayout
```

app/layout.js

```
 import localFont from "next/font/local";
import "./globals.css";
import {Outfit} from 'next/font/google'
import { ClerkProvider } from "@clerk/nextjs";
import Provider from "./provider";
import { Toaster } from
   "@/components/ui/sonner";
export const metadata = {
  title: "AdaptIQ",
  description: "Generated by create next app",
};

const outfit=Outfit({subsets:['latin']});

export default function RootLayout({ children }) {
  return (
    <ClerkProvider>
    <html lang="en">
      <body
        className={outfit.className}
      >
        <Provider>
          {children}
        </Provider>
        <Toaster />
      </body>
    </html>
    </ClerkProvider>
  );
```

app/layout.js

```
import localFont from "next/font/local";
import "./globals.css";
import {Outfit} from 'next/font/google'
import { ClerkProvider } from "@clerk/nextjs";
import Provider from "./provider";
import { Toaster } from "@/components/ui/sonner";
export const metadata = {
title: "AdaptIQ",
description: "Generated by create next app",
};

const outfit=Outfit({subsets:['latin']});

export default function RootLayout({ children }) {
return (
<ClerkProvider>
<html lang="en">
<body
className={outfit.className}
>
<Provider>
{children}
</Provider>
<Toaster />
</body>
</html>
</ClerkProvider>
  );
}
```

```
return model


input_shape = 224, 224, 3
n_plt.figure(figsize=(20, 8))
plt.plot(history.history['accuracy']
])

for i in range(epochs):
if i%5 == 0:
```

app/layout.js

```
import localFont from "next/font/local";
import "./globals.css";
import {Outfit} from 'next/font/google'
import { ClerkProvider } from "@clerk/nextjs";
import Provider from "./provider";
import { Toaster } from "@/components/ui/sonner";
export const metadata = {
  title: "AdaptIQ",
  description: "Generated by create next app",
};

const outfit=Outfit({subsets:['latin']});

export default function RootLayout({ children }) {
  return (
    <ClerkProvider>
    <html lang="en">
      <body
        className={outfit.className}
      >
        <Provider>
          {children}
        </Provider>
        <Toaster />
      </body>
    </html>
    </ClerkProvider>
  );
}
```

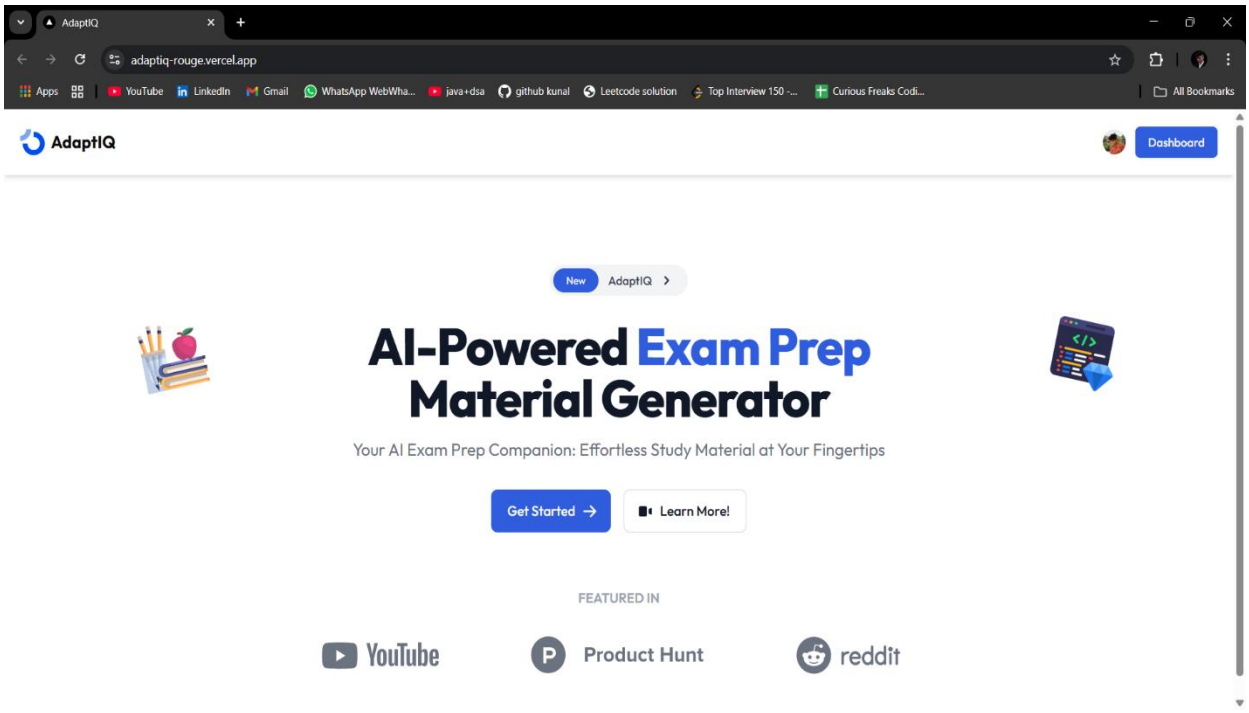
app/provider.js

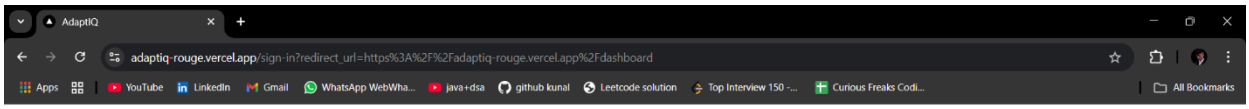
```
"use client";

import { db } from '@/configs/db';
import { USER_TABLE } from
'@/configs/schema';
import { useUser } from
'@clerk/nextjs';
import axios from 'axios';
import { eq } from 'drizzle-orm';
import React, { useEffect } from
'react';

function Provider({ children }) {
    const { user } = useUser();

    useEffect(() => {
        if (user) {
            CheckIsNewUser();
        }
    }, [user]);

    /**
     * Used to check if the user is new or not
     */
    const CheckIsNewUser = async () =>
{
        // Check if user already exists
        const result = await db.select().from(USER_TABLE);
    };
 .where(eq(USER_TABLE.email, user?.primaryEmailAddress?.emailAddress))

        if (result?.length == 0) {
            const userResp = await db.insert(USER_TABLE).values({
              name: user?.fullName,
              email: user?.primaryEmailAddress?.emailAddress
            }).returning({ id: USER_TABLE.id })

}
```

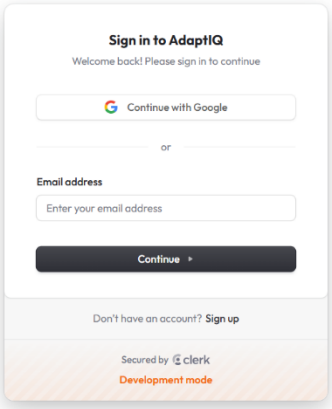
```
        //const resp=await
    axios.post('/api/create-
    user',{user:user});
        //console.log(resp.data);

    }
    return (
        <div>


            {children}
        </div>
    )
}

export default Provider
```

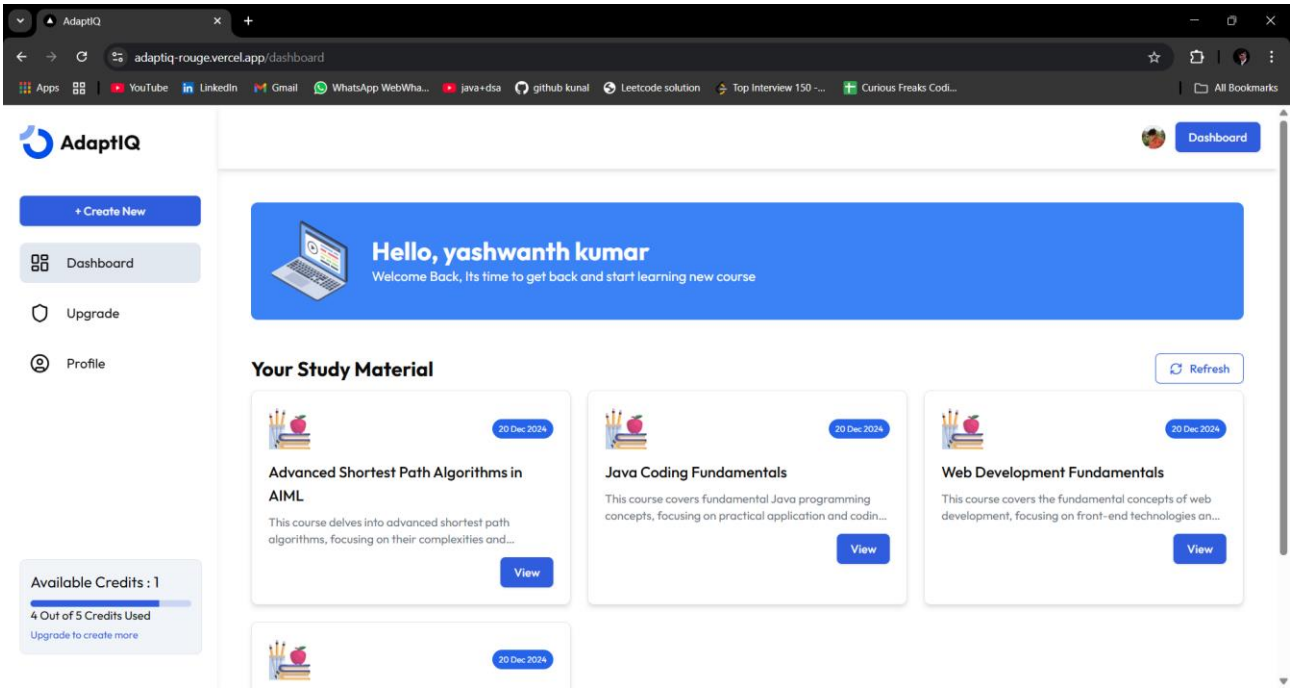
APPENDIX II

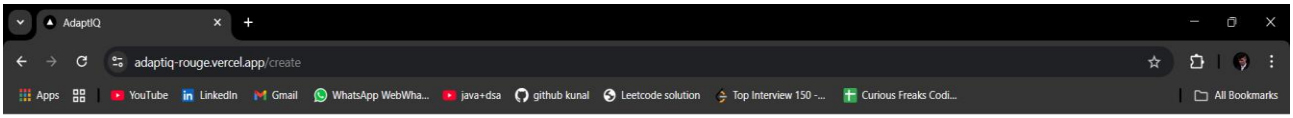
OUTPUT SCREENSHOTS











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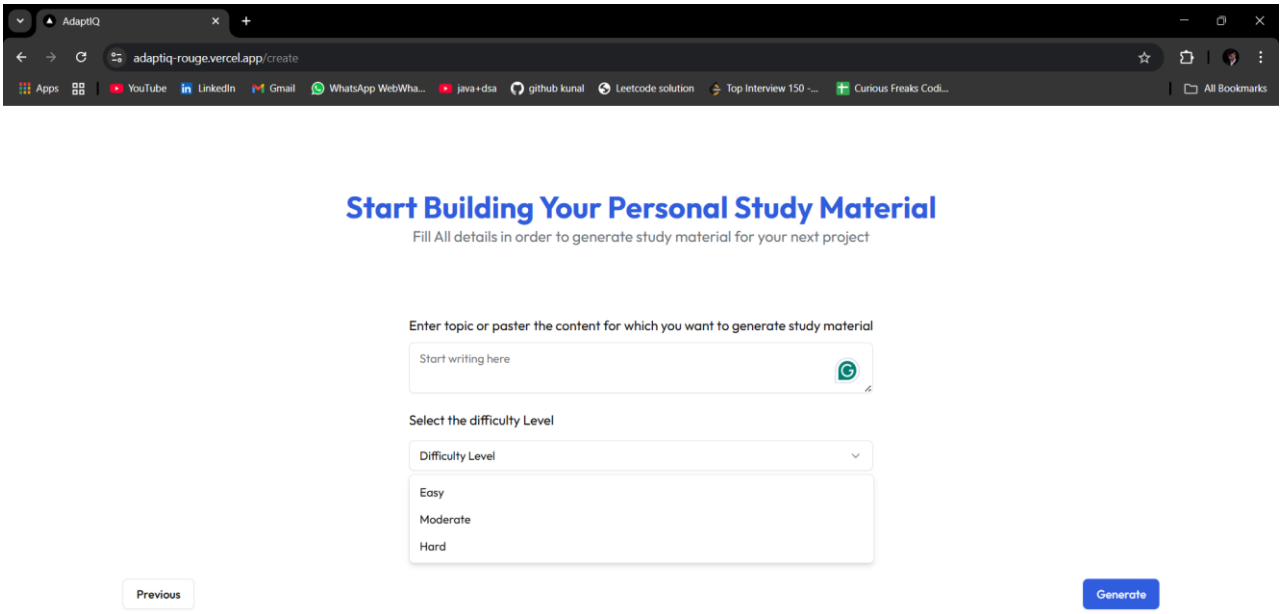
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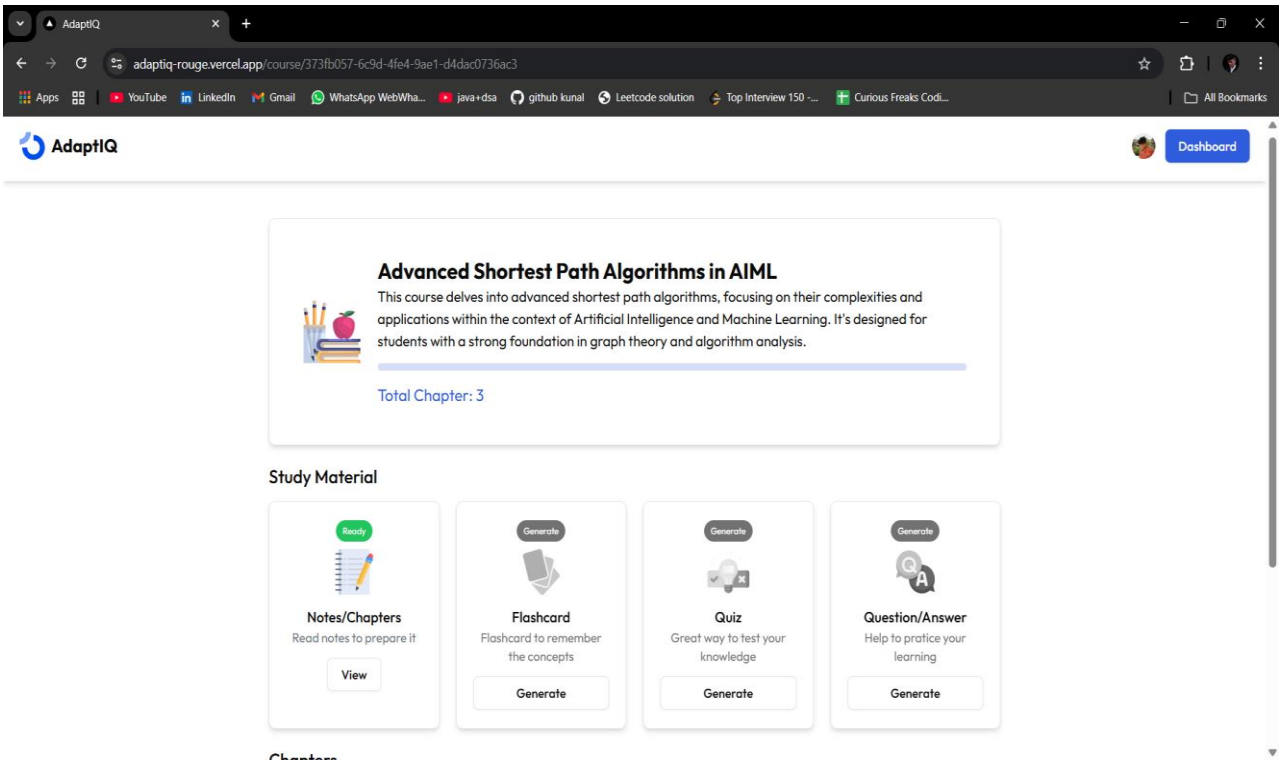
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Advanced Shortest Path Algorithms in AIML
This course delves into advanced shortest path algorithms, focusing on their complexities and applications within the context of Artificial Intelligence and Machine Learning. It's designed for students with a strong foundation in graph theory and algorithm analysis.
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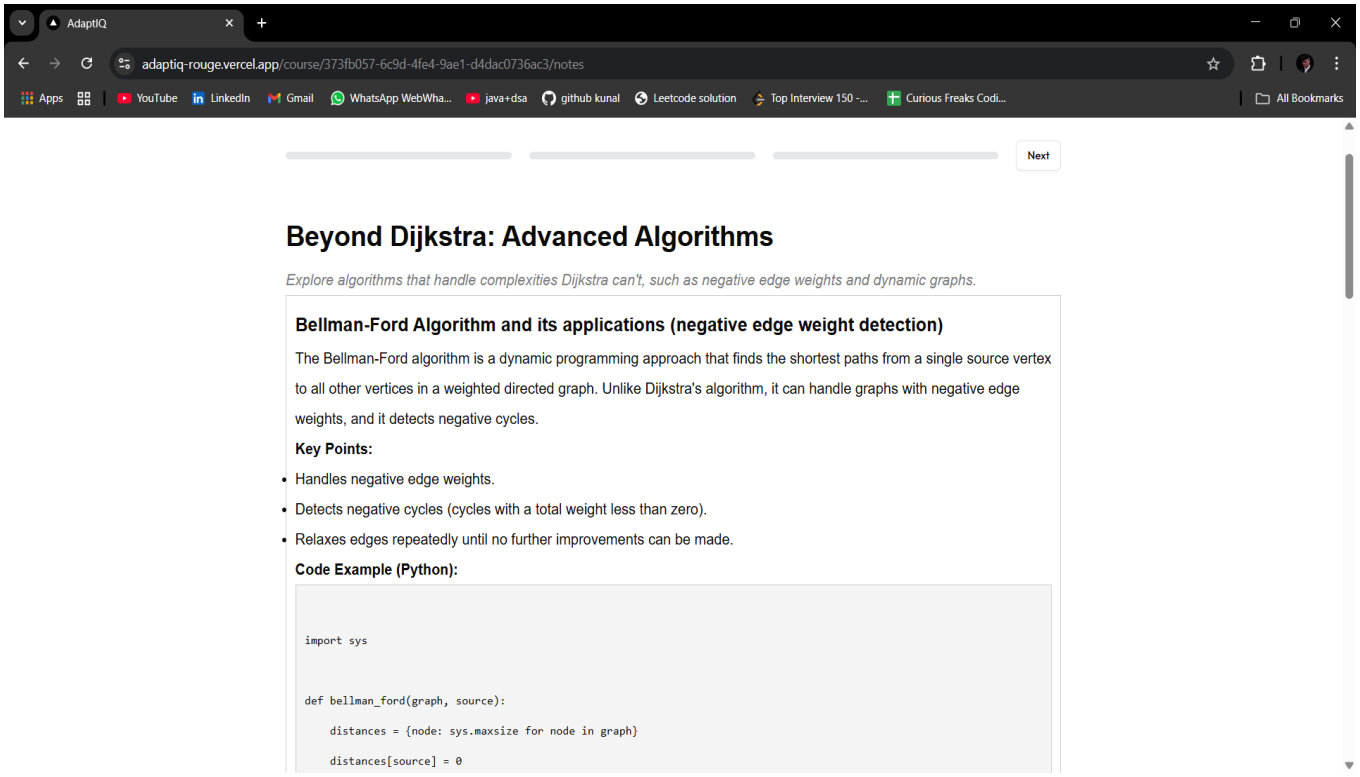
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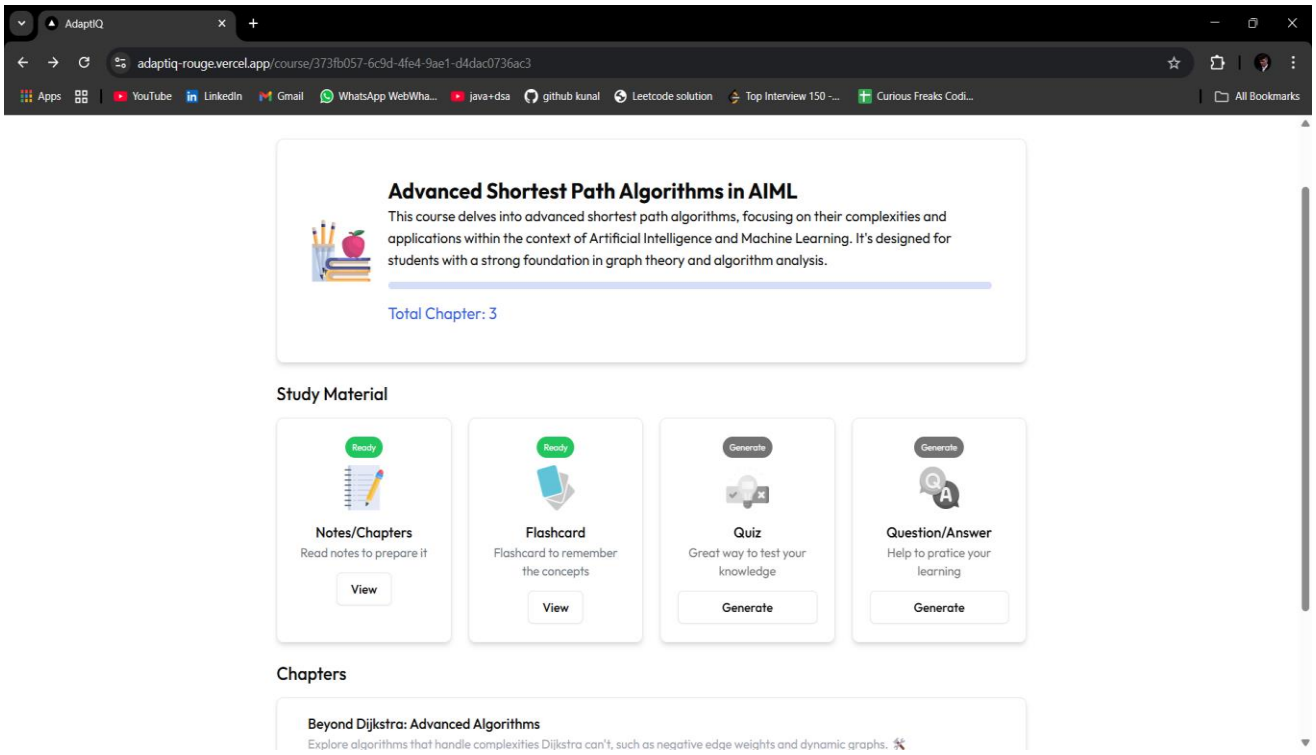
Beyond Dijkstra: Advanced Algorithms
Explore algorithms that handle complexities Dijkstra can't, such as negative edge weights and dynamic graphs.
Bellman-Ford Algorithm and its applications (negative edge weight detection)
The Bellman-Ford algorithm is a dynamic programming approach that finds the shortest paths from a single source vertex to all other vertices in a weighted directed graph. Unlike Dijkstra's algorithm, it can handle graphs with negative edge weights, and it detects negative cycles.
Key Points:
Handles negative edge weights.
Detects negative cycles (cycles with a total weight less than zero).
Relaxes edges repeatedly until no further improvements can be made.
Code Example (Python):
import sys
def bellman_ford(graph, source):
distances = {node: sys.maxsize for node in graph}
distances[source] = 0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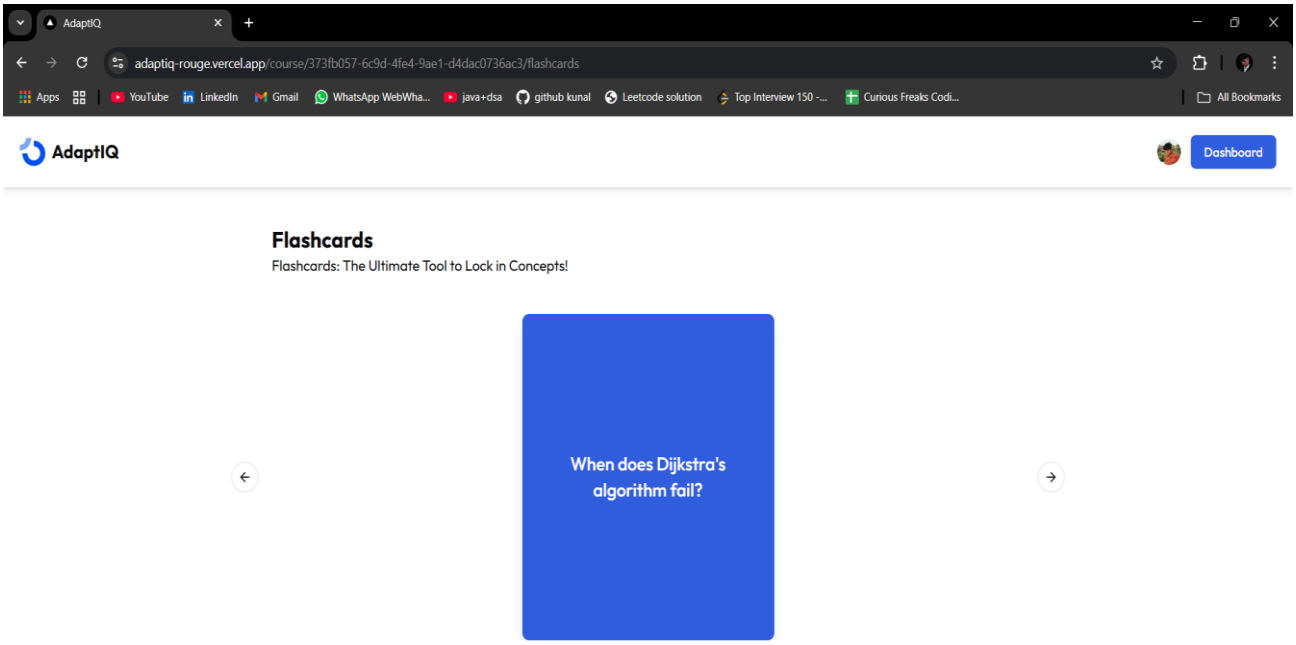
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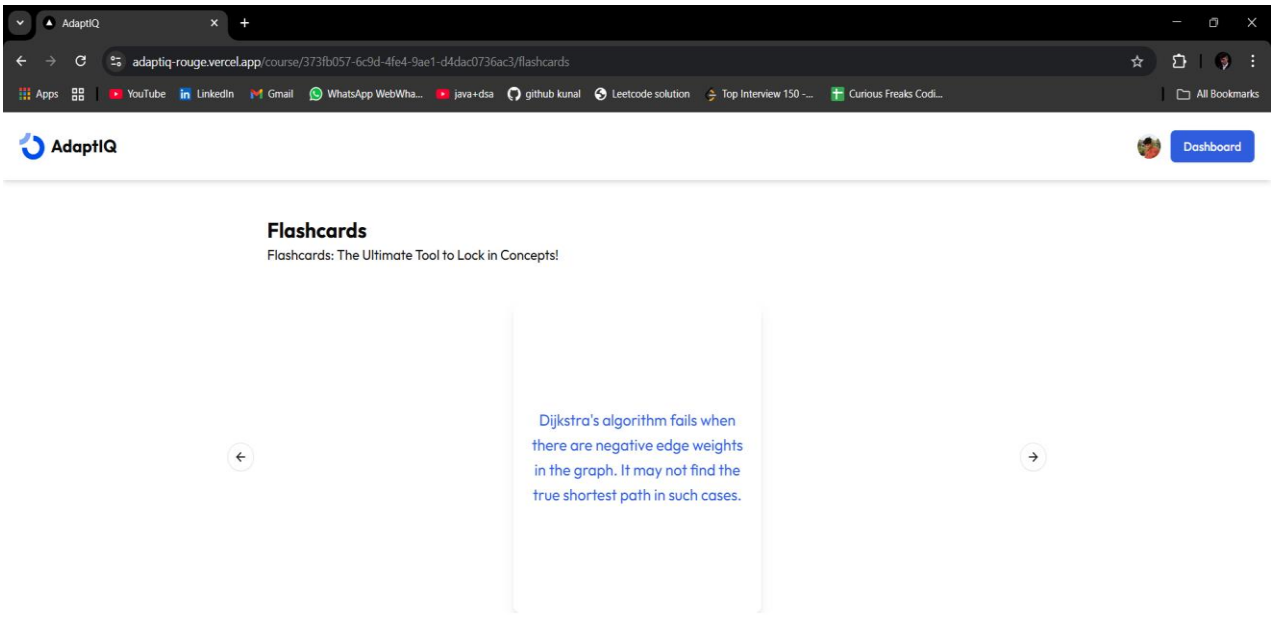
When does Dijkstra's algorithm fail?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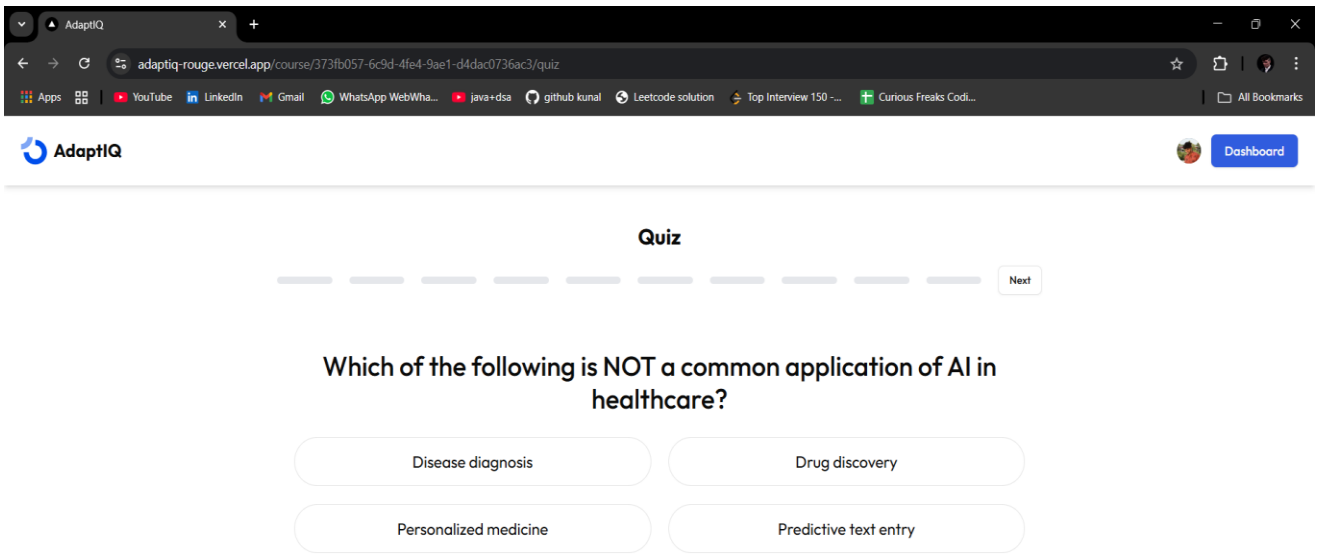
Dijkstra's algorithm fails when there are negative edge weights in the graph. It may not find the true shortest path in such cases.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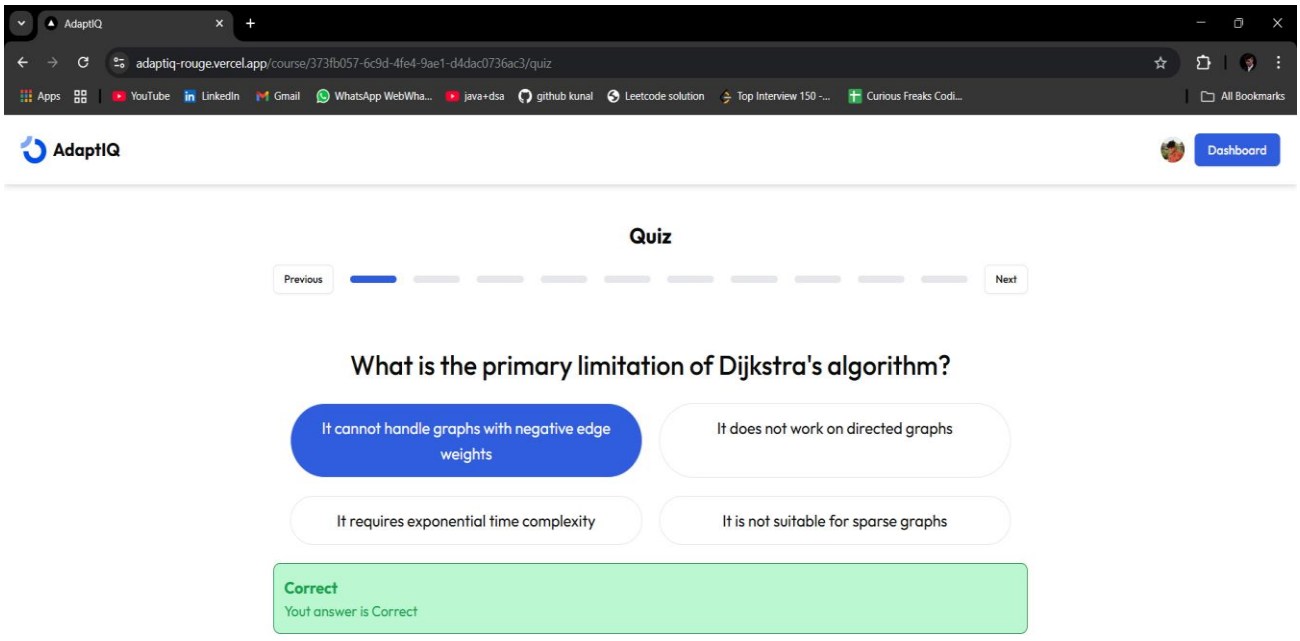
Which of the following is NOT a common application of AI in healthcare?
Disease diagnosis
Drug discovery
Personalized medicine
Predictive text entry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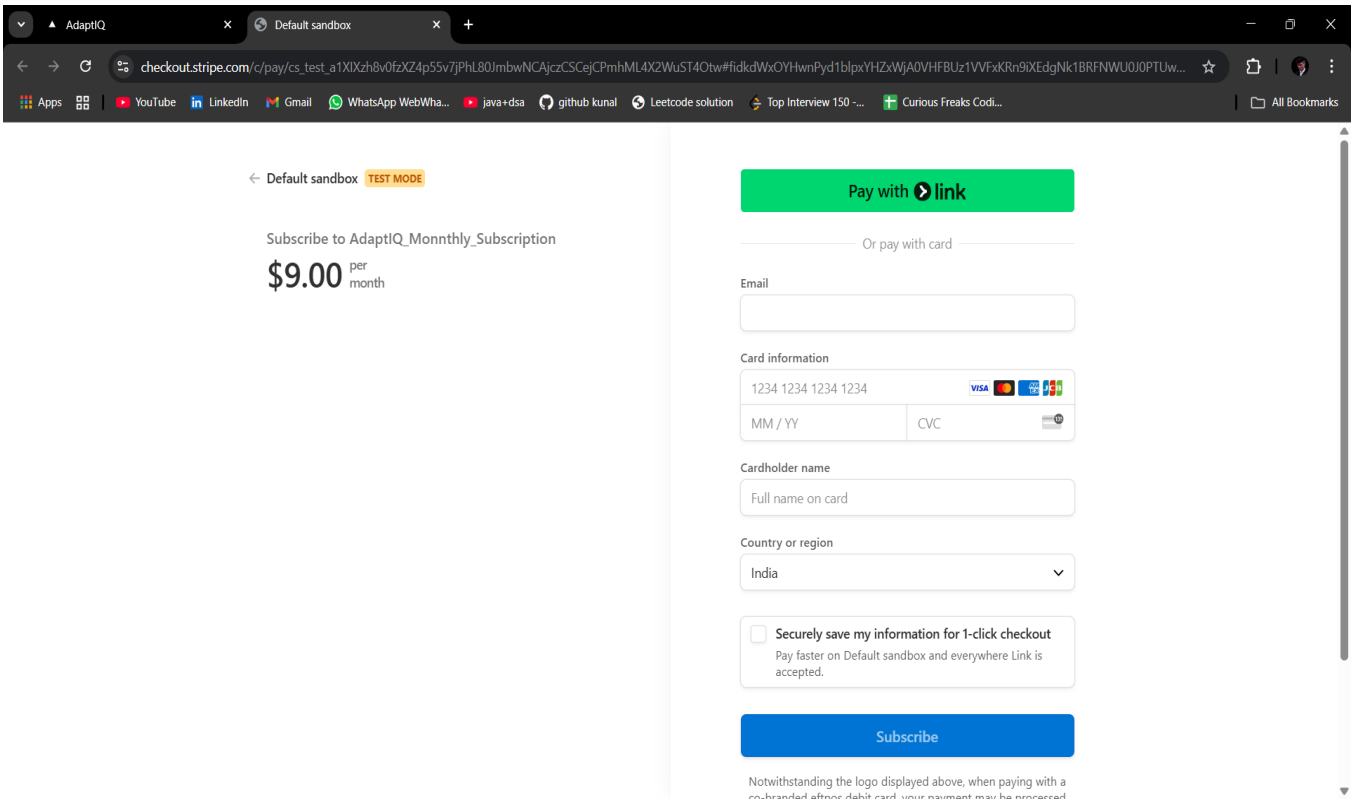
What is the primary limitation of Dijkstra's algorithm?
It cannot handle graphs with negative edge weights
It does not work on directed graphs
It requires exponential time complexity
It is not suitable for sparse graphs
Correct
Yout answer is Correct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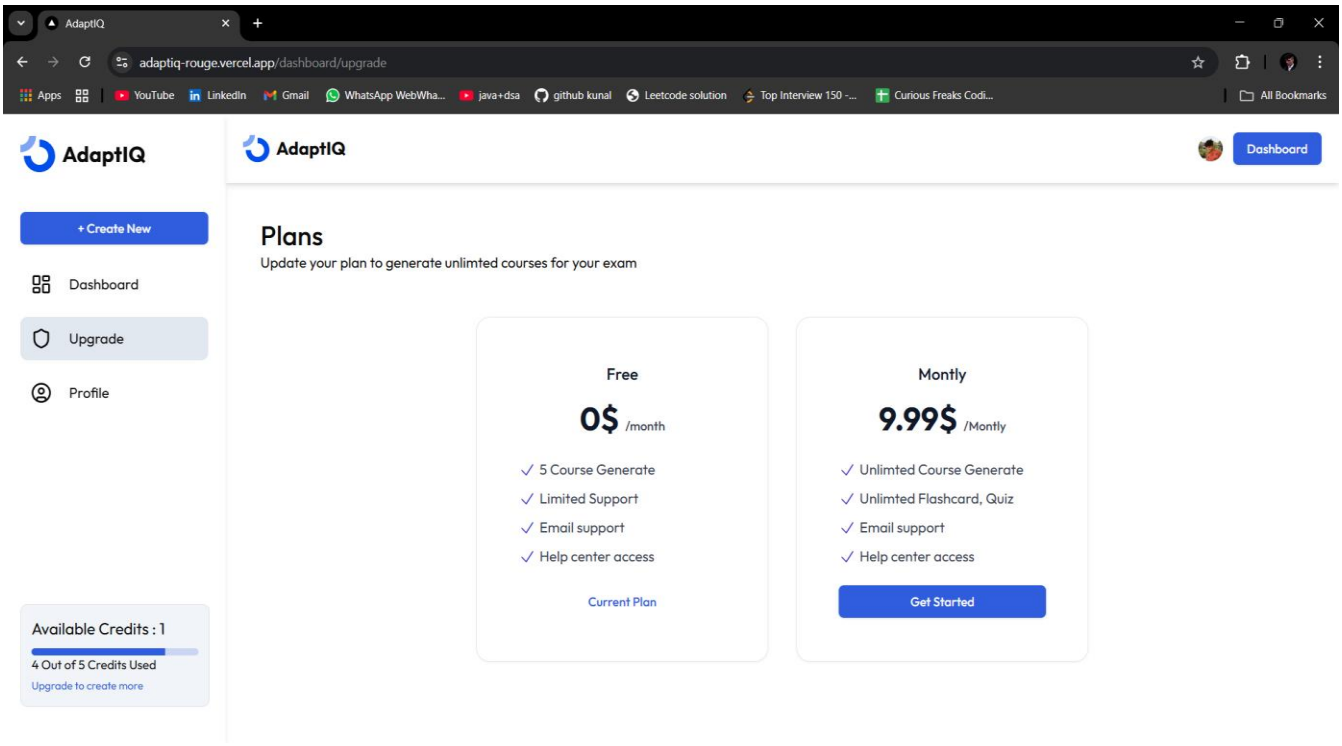
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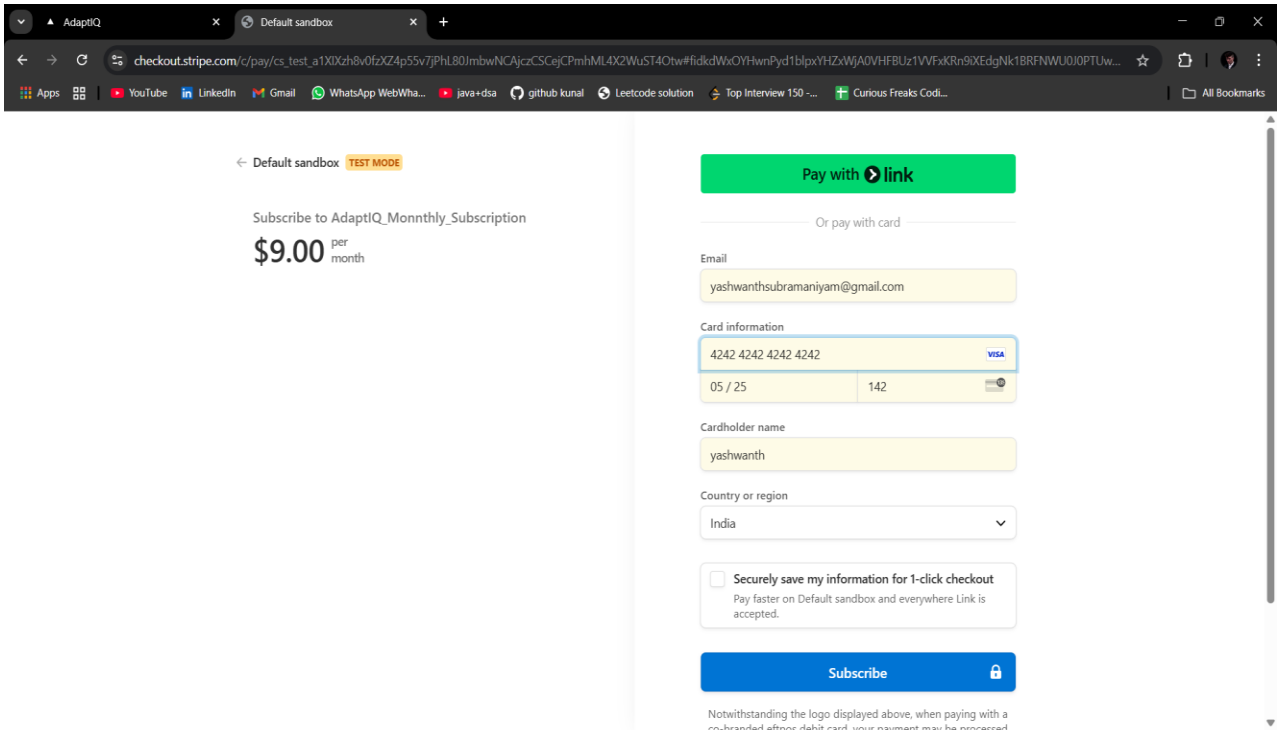
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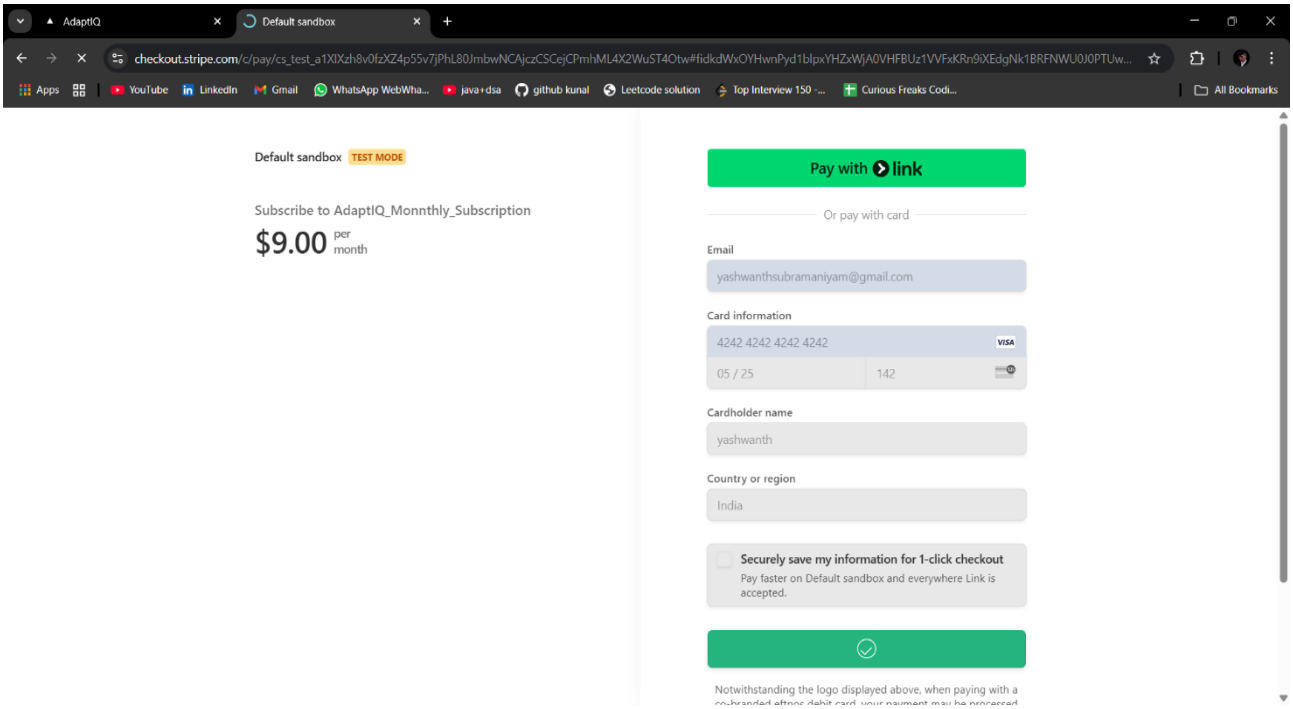
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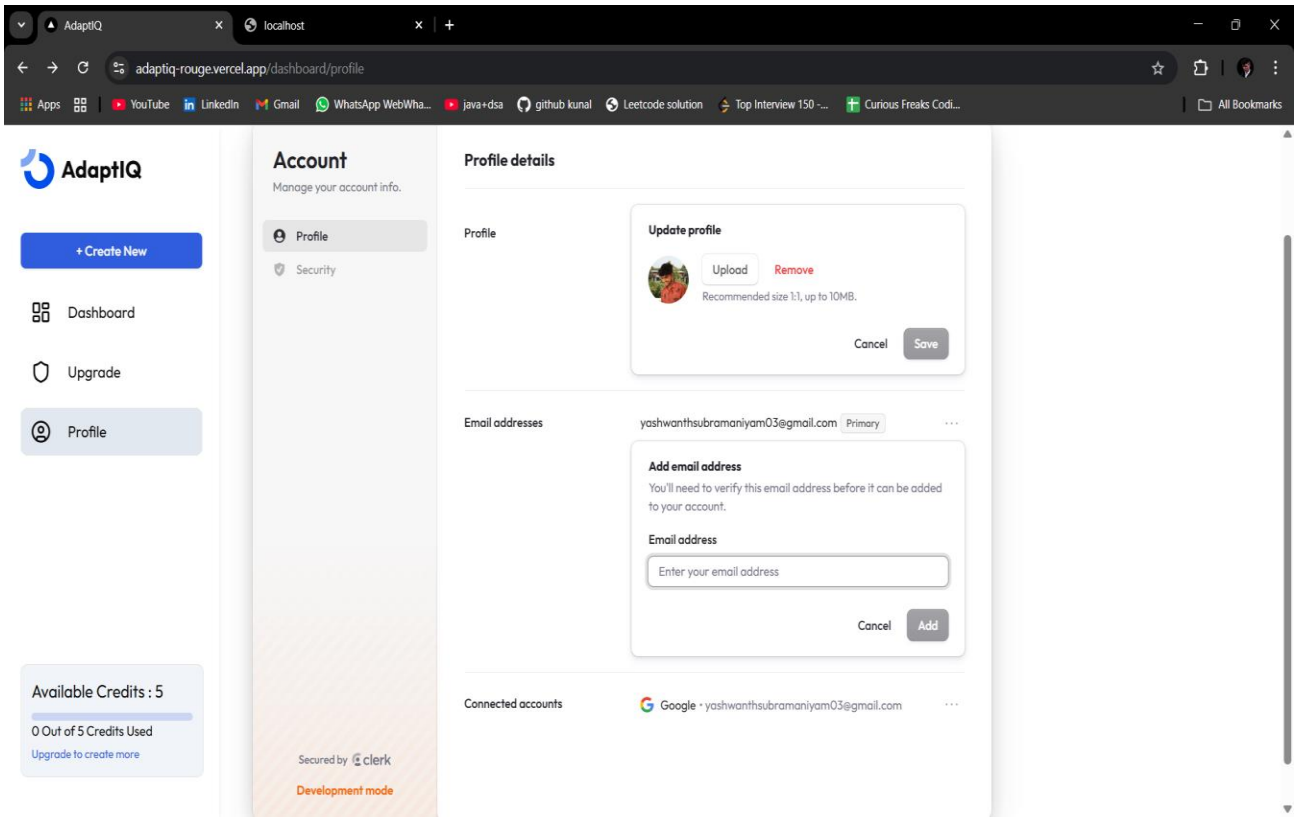
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