1. Project Overview

Project Name:

summArIze

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2. Problem Statement

Many students struggle to keep up with lectures, long readings, and study materials. College and high school students often feel overwhelmed and don't have enough time to review everything before exams. Notes can be confusing, videos are long, and studying is not always effective. Our app solves this problem by using AI to summarize text, videos, and lectures, create quick study guides, and generate quizzes so students can learn faster, understand better, and study more efficiently.

3. Goals and Objectives

The main goal of SummArIze is to help students take control of their academic success through intelligent AI-powered study support. The platform focuses on simplifying the process of understanding lectures, organizing notes, generating practice quizzes, and tracking progress all in one place to improve learning efficiency and retention.

Objectives:

1. Intelligent Summarization

Provide AI-generated summaries that extract key concepts, definitions, and main ideas from text and video content, making complex material easier to understand.

2. Automated Note Generation

Convert raw lecture content into clean, organized notes with headings, bullet points, and highlighted key takeaways.

3. Active Learning Support

Generate quizzes (multiple choice, true/false, short answer) from uploaded content and provide instant feedback with explanations to reinforce understanding.

4. Centralized Study Platform

Allow users to upload notes, documents, or lecture materials and access all AI-generated summaries, quizzes, and notes within a single dashboard.

5. Multi-AI Integration

Implement a modular AI architecture that utilizes multiple cloud AI services to handle different tasks (summarization, quiz generation, feedback), demonstrating scalable and advanced AI system design.

6. User-Friendly Experience

Deliver a clean, intuitive interface that allows users to upload content, generate study materials, and review results quickly and seamlessly.

4. Required (Core Functionality)

These are must-have features for summArIze to function properly.

- User Accounts: Users must be able to sign up, log in, and securely store their data using Firebase Authentication and Firestore. User generated summaries, notes, and quizzes will be saved to their account.

- Text Upload & Input: Users can paste text or upload documents (e.g., lecture notes, readings, PDFs) for AI processing.

- AI Text Summarization: The system generates concise summaries from uploaded or pasted content, extracting key concepts and main ideas.

- Automated Note Generation: AI converts raw content into structured notes with headings, bullet points, and highlighted key terms.
- Quiz Generation: The system generates practice quizzes (multiple choice, true/false, short answer) based on the summarized material.
- Instant Feedback & Answer Evaluation: AI evaluates user quiz responses and provides explanations for correct and incorrect answers.
- Dashboard: Displays saved summaries, generated quizzes, and past study sessions in a centralized, easy-to-navigate interface.
- Database Integration: Firestore stores user content, summaries, quizzes, quiz attempts, and progress history securely.

Desired (Improves Usability & Appearance)

These features improve usability, engagement, and overall user experience but are not required for core functionality.

- Progress Dashboard: Visual charts displaying study activity, number of summaries generated, quiz performance over time, and study streaks to motivate users and reinforce progress.
- Profile Customization: Users can upload profile pictures and personalize study preferences such as learning style, difficulty level, and AI response format (bullet points, simplified explanations, detailed explanations).
- Responsive UI/UX Design: A clean, distraction-free interface that works smoothly on desktop and mobile devices. Organized workflow structure: Upload → Summary → Quiz → Feedback.
- Searchable Notes Library: Users can search, filter, and revisit previously uploaded documents, summaries, and quizzes by subject, class, or date.
- File Preview Before Processing: Users can preview uploaded PDFs before generating summaries and optionally highlight important sections.
- Notifications and Study Reminders: Optional reminders to review notes, complete quizzes, or maintain study streaks.
- Dark Mode: Optional interface theme to reduce eye strain during extended study sessions.

Aspirational (Stand-Out & Advanced Features)

These features differentiate SummArIze from other study tools and position it as a next-generation AI learning assistant.

- AI Study Coach: A conversational AI agent that answers follow-up questions, explains difficult concepts in simpler terms, and provides interactive tutoring support.

Multi-Agent Architecture: Separate AI agents for:

- Text Summarization
- Video/Lecture Processing
- Quiz Generation
- Evaluation and Feedback

Each agent can be powered by different cloud AI APIs and orchestrated within a single system.

- Personalized Study Plans: AI-generated weekly study schedules based on deadlines, exam dates, difficulty level, and past quiz performance.
- LMS Integration: Integration with platforms such as Canvas or Google Classroom to automatically import assignments or syllabi.
- Gamification: Badges, streaks, study milestones, and optional leaderboards to encourage consistent engagement.
- Voice-to-Notes Processing: Users can upload lecture audio recordings that are automatically transcribed and summarized.
- Premium AI Analytics: Advanced feature offering deep performance insights such as topic mastery analysis, weak concept detection, adaptive quiz difficulty, and exam-readiness prediction.

5. Target Audience

SummArIze is designed for students and academic learners who want to improve study efficiency using AI-powered tools.

The primary audience includes:

- College students between the ages of 18–25
- Students balancing multiple courses and limited time
- Individuals preparing for midterms, finals, or competitive exams

Many students experience challenges such as:

- Overwhelming volumes of reading material

- Disorganized notes
- Inefficient study strategies
- Difficulty understanding complex concepts

SummArIze provides structured AI-generated summaries, interactive quizzes, and personalized feedback to simplify studying and improve knowledge retention.

It is particularly valuable for:

- STEM students managing dense academic material
- Working students with limited study time
- Learners who benefit from adaptive and interactive studying

SummArIze targets motivated, goal oriented students who seek clarity, efficiency, and academic confidence through intelligent AI assistance.

6. Technical Requirements

SummArIze is designed using a multi-cloud, multi-agent architecture that leverages Google Cloud, Amazon Web Services (AWS), and Microsoft Azure. Each cloud platform is used for a specific purpose to ensure scalability, modularity, and intelligent AI orchestration.

1. Frontend Framework

• Next.js (React Framework)

The application is built using Next.js to provide a fast, scalable, and server-side rendered web application.

It supports a responsive user interface and structured study workflow (Upload → Transcription → Summary → Quiz → Feedback).

2. Database and Storage (Google Cloud)

• Google Firestore

Firestore is used as a cloud-based NoSQL database to securely store:

- User profiles

- Uploaded document metadata
- Audio transcription results
- Generated summaries
- Study guides
- Quiz questions and results

Firestore provides real-time data synchronization and scalable per-user storage.

• Firebase Storage

Firebase Storage securely stores uploaded PDFs, lecture audio files, and other study materials before processing.

3. AI Services (Multi Cloud Architecture)

SummArIze uses separate AI services across multiple cloud providers to meet the requirement of using all three clouds and implementing agent-based AI.

Google Cloud – Gemini API

The Gemini API serves as the core AI engine. It is responsible for:

- Summarizing lecture notes and readings
- Extracting key concepts
- Generating structured study guides
- Creating quiz questions

Gemini powers the primary intelligence layer of the system.

Amazon Web Services – AWS Transcribe

AWS Transcribe is used for speech-to-text processing. It:

- Converts uploaded lecture audio or video files into text
- Produces transcripts that are stored in Firestore
- Sends transcript data to the Summarization Agent for further processing

This enables multimodal learning support (audio and text input).

Microsoft Azure – Azure AI Foundry

Microsoft Azure AI Foundry is used to manage agent orchestration and integration. It:

- Hosts and organizes separate AI agents
- Supports evaluation workflows
- Connects the summarization, quiz generation, and feedback agents

This satisfies the requirement that each team member develops an AI agent and integrates them into a unified system.

4. Multi-Agent Architecture

SummArIze follows an agent-based AI design. Each major feature is handled by a separate AI agent:

• Summarization Agent

Processes lecture text or transcripts and generates structured summaries.

• Quiz Generation Agent

Creates practice questions based on summarized material.

• Evaluation Agent

Grades quizzes and provides personalized feedback.

• Transcription Agent

Handles speech-to-text conversion using AWS Transcribe.

These agents communicate through secure backend API routes and are connected into a single intelligent study workflow.

5. Backend Logic

• Next.js API routes manage:

- Secure communication with Gemini, AWS Transcribe, and Azure AI services
- File validation and preprocessing
- Agent-to-agent data transfer
- Authentication and authorization checks

All AI requests are handled server-side to protect API credentials.

6. Authentication and Security

• Firebase Authentication is used for secure sign-up, login, and account management.

• All data transmission is encrypted using HTTPS.

• API keys are stored securely in environment variables.

• Firestore security rules ensure users can only access their own data.

7. Hosting and Deployment

• The application is deployed on Vercel to provide:

- Global edge delivery
- Automatic scaling
- Continuous deployment through GitHub integration

8. Performance Requirements

• AI response time should be under 10 seconds for summaries and quizzes.

• Audio transcription processing should complete efficiently before summarization.

• Dashboard updates should reflect user activity in real time using Firestore.

• The architecture must support multiple concurrent users.

9. System Objective

The objective of this architecture is to integrate:

- Google Cloud (Gemini API and Firestore)
- Amazon Web Services (AWS Transcribe)
- Microsoft Azure (Azure AI Foundry for agent orchestration)

into a unified, intelligent, multi-agent AI study assistant that improves student learning efficiency and academic performance.