1. Overview Section

Document Title: Vidyut Learning Platform PRD

Prepared By: Yashas Patil

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Executive Summary:

The Vidyut Learning Platform is an innovative, AI-assisted quiz-based learning tool designed to offer a self-paced and personalized educational experience, initially focusing on Computer Science Engineering (CSE) topics. The primary purpose of this platform is to empower students to effectively learn and master complex subjects by engaging with dynamically generated quizzes, receiving in-depth explanations for answers, and benefiting from an adaptive system that identifies and addresses individual learning weaknesses. Key features include personalized profile management where users can set topic preferences and current knowledge levels, and an LLM-powered engine for quiz question generation, adaptive difficulty adjustments, and comprehensive answer summaries. Furthermore, the platform will incorporate a progress dashboard for students to track their learning journey, a chatbot for immediate assistance with basic concepts, a structured feedback mechanism for continuous improvement, and a topic recommendation system to guide further learning.

2. Objectives & Goals

Objectives:

The Vidyut Learning Platform is designed with the following primary objectives:

- To provide a highly personalized and adaptive learning experience tailored to the individual pace and knowledge level of Computer Science Engineering (CSE) students. This involves dynamically adjusting quiz difficulty and content based on ongoing performance.
- To enable students to achieve a deep and thorough understanding of CSE topics. This will be accomplished through AI-generated quizzes that cover a wide spectrum of concepts, complemented by comprehensive and clear explanations for every answer.
- To offer a robust mechanism for accurately identifying and systematically addressing individual learning weaknesses. When a student struggles with a concept, the platform will provide targeted questions to reinforce understanding before progressing.
- To empower students by allowing them to track their learning progress effectively and gain actionable insights into their strengths and areas needing improvement. This will be facilitated through a clear and intuitive progress dashboard.

Goals:

To achieve the above objectives, the platform will strive to meet the following specific goals:

- Develop and deploy a publicly accessible web platform under the domain "Vidyut".
- Create user roles : students and teachers. (Currently focusing on students as user)
- Allow users to create and manage their profiles, including specifying their name, preferred CSE learning topics (one at a time initially), and their self-assessed current knowledge level for each selected topic.
- Utilize advanced Large Language Models (LLMs) to dynamically generate relevant Multiple Choice Questions (MCQs) based on the user's chosen topic, **current proficiency, and the platform's adaptive difficulty algorithm.**
- Provide LLM-generated, detailed, and easy-to-understand explanations for each quiz answer, covering concepts from **foundational to advanced levels to ensure comprehensive learning.**
- Implement an adaptive difficulty progression system where the complexity of quiz questions increases incrementally as a student demonstrates mastery by consistently answering questions correctly.
- Develop and integrate a sophisticated **weakness-addressing mechanism**. This involves presenting the correct answer and explanation for an incorrectly answered question**, followed by LLM-generated, targeted, lower-difficulty questions based on the explanation of the missed concept to solidify understanding**.
- Create a module **where user can take tests** which resemble traditional test environment followed by a test-wise analysis promoting self-evaluation.
- Create a comprehensive user profile page that includes a **visual progress dashboard**, allowing students to monitor their learning journey, track performance across different topics, and identify areas for further study.
- Enable users to select and switch between multiple CSE topic preferences, with the platform saving and resuming progress independently for each topic.
- Integrate an **LLM-powered chatbot to provide instant support for beginner-level** queries and clarification of basic concepts, ensuring students have foundational knowledge before or during quiz sessions.
- Incorporate a **structured feedback system** that prompts users for input upon leveling up and allows for voluntary feedback submission through their profile. This feedback will be tracked and analyzed for continuous platform improvement.
- Implement a **topic recommendation engine** that suggests related or subsequent CSE topics for study once a student achieves a certain level of mastery in their current topic, guiding their learning path.
- Implement a provision for **documenting the quiz work** in the form of notes through formats such as PDFs for set of 10,20 questions.
- *Bottom Line: Hybrid approach of "Quiz + Learning Mode" combined with "Test Quiz Mode" for effective learning and self evaluation.*

3. Target Users

Primary Users:

The primary target users for the Vidyut Learning Platform are Computer Science Engineering (CSE) students as of now. This group encompasses individuals at various stages of their academic journey, including:

- Undergraduate students seeking to supplement their coursework, prepare for exams, or deepen their understanding of core CSE concepts.
- Graduate students looking to review foundational topics or explore new specializations within CSE.
- Self-learners and professionals aiming to acquire or update their knowledge in specific CSE domains for career advancement or personal interest.

Platform Administrators: Individuals responsible for the maintenance, monitoring, and overall management of the Vidyut Learning Platform. Their tasks would include ensuring system uptime, managing user accounts (if necessary, beyond automated processes), overseeing the LLM integrations, and potentially curating or reviewing content generation parameters to maintain quality and relevance.

4. Features

F1: User Authentication & Profile Management

This set of features allows users to securely access the platform and manage their learning preferences.

- **F1.1: Sign-in/Sign-up:**
  - **Workflow:** Users can create an account using their email address and a password, or sign in using their existing Google account (OAuth 2.0 integration).
  - **System Response:** Upon successful authentication, users are directed to their profile page (if new) or the last active learning topic/dashboard.
- **F1.2: Profile Creation/Update:**
  - **Workflow:** New users are prompted to enter their name. All users must select a primary Computer Science Engineering (CSE) topic they wish to study (e.g., "Data Structures", "Machine Learning") and indicate their current self-assessed knowledge level in that topic (e.g., "Beginner", "Intermediate", "Advanced"). Users can update their name and topic preferences/levels at any time through their profile page.
  - **System Response:** The system stores this information to personalize quiz content and track progress.
- **F1.3: Progress Dashboard & Test Analysis:**
  - **Workflow:** Accessible from the user's profile, the dashboard will provide a visual representation of their learning journey in the Quiz+Learning mode. This

includes overall progress in active topics, mastery levels achieved, strengths, and areas needing improvement. A separate "**Test Analysis**" section will store and display reports from completed Test Quizzes, highlighting weaker sections and concepts based on test performance.

- **System Response:** The dashboard will display charts and statistics summarizing Quiz+Learning performance. The Test Analysis section will provide detailed reports for each test taken.

- **F1.4: Multiple Topic Preference Management:**
    - **Workflow:** Users can select and switch between multiple CSE topics for both Quiz+Learning and Test Quiz modes. Each topic will be treated as a separate learning stream.
    - **System Response:** The platform will save and retrieve progress (current level, quiz history for Quiz+Learning; test history and analysis for Test Quiz) independently for each topic.

- **F1.5: Documentation of Quiz Questions and answers:**
    - **Workflow:** Users can have their question and answers saved as notes
    - **System Response:** The platform will retrieve the filtered Questions and answers on a particular topic as chosen by user and generate a PDF of the same.

F2: AI-Powered Quiz Engine (Quiz+Learning Mode)

This is the core adaptive learning component, driven by Large Language Models (LLMs).

- **F2.1: LLM-based MCQ Generation:** (As previously defined)
- **F2.2: One-at-a-time Question Presentation:** (As previously defined)
- **F2.3: Answer Submission and Immediate Feedback:** (As previously defined)
- **F2.4: LLM-generated Deep Answer Explanations:** (As previously defined)

F3: Adaptive Learning Path (Quiz+Learning Mode)

This feature ensures the learning experience is tailored to the student's performance in the Quiz+Learning mode.

- **F3.1: Difficulty Level Progression:** (As previously defined)
- **F3.2: Weakness Identification:** (As previously defined)
- **F3.3: Targeted Remedial Quizzes:**
  User chooses a wrong answer for question → Provide the correct answer with explanation. → User understands the concept →generate 3-4 questions of level lower than that of currently wrong answered question by taking reference of summary → User will get comfortable with particular weak point
- **F3.4: Mastery Check:**
  Once user is comfortable answering lower level difficulty questions → Give user a question of caliber of their original level(where they failed earlier)
  F3.3 and F3.4 as shown in flow diagram below.
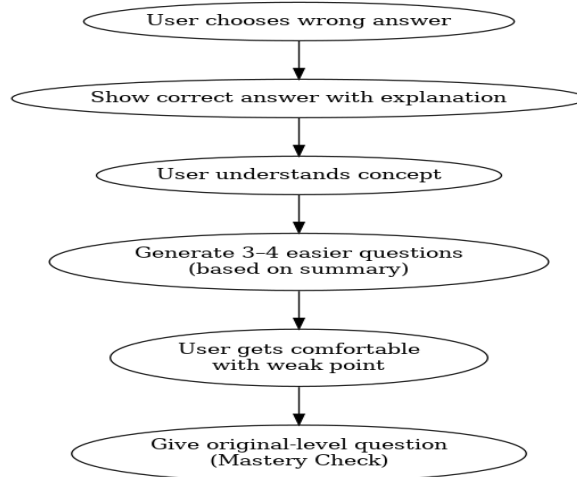
F4: Test Quiz Mode (Formal Assessment)

This feature provides a formal, timed testing environment.

- **F4.1: Test Initiation & Configuration:**
    - **Workflow:** Users can select a topic and initiate a "Test Quiz". The test will consist of a predefined number of questions (e.g., 20) and will be timed.
    - **System Response:** The system prepares a batch of questions (potentially LLM-generated or from a curated bank for consistency in testing) appropriate for the chosen topic.
- **F4.2: Timed Test Interface:**
    - **Workflow:** Questions are presented to the user. A timer is visible. Users answer questions sequentially.
    - **System Response:** The interface allows navigation between questions if permitted by test design, and tracks time.
- **F4.3: Test Submission & Reporting:**
    - **Workflow:** Users submit the test upon completion or when time expires.
    - **System Response:** The system grades the test and generates a comprehensive report. The report includes the overall score, question-by-question results (user's answer, correct answer), and an analysis of performance, highlighting weaker areas or concepts.
- **F4.4: Test Analysis Storage:**
    - **Workflow:** The generated test report and analysis are saved to the user's profile under the "Test Analysis" section (F1.3).
    - **System Response:** Users can access and review past test results and analyses at any time.

F5: Chatbot Support

Provides on-demand assistance to students, primarily for the Quiz+Learning mode.

- **F5.1: LLM-powered Chatbot:** (As previously defined)

F6: Feedback Mechanism

Allows users to contribute to platform improvement across all modes.

- **F6.1: Feedback Prompt on Level-Up (Quiz + Learning):** automatically triggered after level-up
- **F6.2: Voluntary Feedback Submission:** user can voluntarily choose to give whenever they wish.

F7: Topic Recommendation Engine

Guides students towards further learning opportunities based on Quiz+Learning progress.

- **F7.1: Recommending Related/Next Topics:**
  User is learning a topic through our quiz. Upon reaching certain level, system should show recommendation of topics that can be learned or taken quiz parallelly. (say for example he is learning C++, upon reaching certain level he can start STL, he can start DS and then algorithms..)

F8: Notes Generation

Allows students to create personal study materials.

- **F8.1: PDF Generation of Questions & Answers:**
  - **Workflow:** Users can select a completed Quiz+Learning session for a topic or a completed Test Quiz from their history.
  - **System Response:** The system will compile the selected questions, their respective correct answers, and the detailed LLM-generated explanations (for Quiz+Learning mode content) or just questions and correct answers (for Test Quiz mode content) into a PDF document. The user can then download this PDF for offline study or note-taking.

5. Additional Sections

5.1. User Stories

User stories define the functionalities of the Vidyut Learning Platform from an end-user perspective, specifically that of a student.

- **US1: Account Management & Personalization**
  - As a student, I want to create and update my profile with my name, preferred Computer Science Engineering (CSE) topic for study, and my current self-assessed knowledge level in that topic.
  - As a student, I want to be able to manage multiple topic preferences and have my progress (Quiz+Learning levels, Test Quiz history) saved independently for each, so I can switch between subjects and resume learning or testing from where I left off in each one.
- **US2: Quiz+Learning Mode (Adaptive Learning)**

- As a student, when using the Quiz+Learning mode, I want to take Multiple Choice Questions (MCQs) that are dynamically generated based on my chosen topic and current knowledge level.
- As a student, in Quiz+Learning mode, I want questions to be presented one at a time with a clear option to submit my answer.
- As a student, in Quiz+Learning mode, I want to receive immediate feedback after submitting my answer, indicating whether I was correct or incorrect, and clearly showing the correct answer.
- As a student, in Quiz+Learning mode, I want to receive a detailed, LLM-generated explanation for each answer, covering concepts in depth so that I can achieve a thorough understanding of the topic, regardless of whether my answer was correct or incorrect.
- As a student, in Quiz+Learning mode, I want the difficulty of the quizzes to adapt to my performance, increasing as I answer correctly and providing support when I struggle, so I remain challenged and engaged but not overwhelmed.
- As a student, in Quiz+Learning mode, if I answer a question incorrectly, I want the system to not only show me the correct answer and explanation but also provide me with 3-4 targeted, simpler questions based on the explanation of the missed concept, so I can specifically address and overcome my weakness.
- As a student, in Quiz+Learning mode, after successfully answering the remedial questions for a concept I struggled with, I want to attempt a test question at my original difficulty level for that concept, so I can confirm I have mastered it before moving on.

- **US3: Test Quiz Mode (Formal Assessment)**
  - As a student, I want to be able to take a formal "Test Quiz" for a chosen topic, consisting of a set number of questions (e.g., 20) with a time limit, so I can experience a real-time testing environment and assess my overall knowledge under pressure.
  - As a student, after completing a Test Quiz, I want to receive a comprehensive report that shows my score, the questions, my answers, and the correct answers, so I can understand my performance.
  - As a student, along with my Test Quiz report, I want to see an analysis of my weaker sections or concepts based on my test performance, so I know which areas to focus on for improvement, and I want this analysis to be saved in my profile.

- **US4: Progress Tracking & Guidance**
  - As a student, I want to access a visual dashboard in my profile that clearly shows my progress in each topic for the Quiz+Learning mode (including current level) and a separate section for my Test Quiz history and analysis reports.
  - As a student, upon reaching a certain level of mastery in a topic through the Quiz+Learning mode, I want to receive recommendations for related or

subsequent CSE topics to learn, so I can be guided on my continuous learning path.

- **US5: Support & Documentation**
  - As a beginner student, or when I need extra help, I want to be able to use an integrated LLM-powered chatbot to ask basic questions and clarify concepts without leaving the platform, so I can get immediate support, especially for the Quiz+Learning mode.
  - As a student, I want to be able to generate and download a PDF document containing the questions, correct answers, and detailed explanations from my Quiz+Learning sessions for a specific topic, or the questions and correct answers from a completed Test Quiz, so I can have them as notes for offline study and revision.

5.2. Design and UX Considerations

- **Intuitive Navigation and Information Architecture:**
  - The platform will feature a clear and consistent navigation system, making it easy for students to access key areas such as their profile, current learning topic, quiz interface, progress dashboard, chatbot, and feedback sections.
- **Clean, Engaging, and Responsive Interface:**
  - A responsive design approach is mandatory, ensuring a consistent and optimized experience across various devices, including desktops, laptops, tablets, and smartphones. Content and controls will adapt fluidly to different screen sizes.
- **Clarity and Readability:**
  - Quiz questions, options, and explanations will be presented clearly and concisely. LLM-generated content will be formatted for easy scanning and comprehension.
- **User Feedback and Progress Indication:**
  - The system will provide immediate and unambiguous visual feedback for user actions, such as answer submission (correct/incorrect), profile updates, and topic selection.
- **Minimized Cognitive Load:**
  - The principle of presenting one piece of information or task at a time will be followed, especially in the quiz interface (one question at a time). This helps maintain focus and reduces cognitive overload.
  - Instructions and system messages will be simple, direct, and easy to understand.
- **Onboarding and Guidance:**
  - New users will experience a simple and guided onboarding process to set up their profile and understand the platform's core functionalities.
  - Contextual help or tooltips may be used sparingly to explain features without being intrusive.

5.3. Use Case Scenarios / Product Flow

Flowchart:

1. Discovery & Access (Student finds platform) →
2. Authentication (Google or Email/Password) →
3. Profile Setup (Name, Topic, Knowledge Level) →
4. Choose Mode: Quiz+Learning or Test Quiz

- Quiz+Learning → 5. Quiz+Learning: LLM generates topic-based MCQs → 6. Submit Answer → Immediate Feedback + Explanation
  - If Correct → 7. Correct? → More Similar Questions → Level Up
  - If Incorrect → 8. Incorrect? → Show Explanation → Generate Easier Questions → 9. Mastery Check → Return to Normal Flow on Success
  - → 10. Repeat Cycle → Gradual Mastery → 19. Topic Recommendations (Based on Progress); 20. PDF Generation (Notes/Quiz Exports)

- Test Quiz → 11. Test Quiz: Timed Full-Length Test → 12. Submit Answers (No Immediate Feedback) → 13. Test Report: Score + Correct/Incorrect Review → 14. Weakness Analysis → Save in Test Analysis Section → 15. Profile & Progress Tracking (Visual Dashboard) → 16. Update Preferences / Topics; 17. Chatbot for Doubts (LLM); 18. Feedback Mechanism

5.5. Success Metrics

The success of the Vidyut Learning Platform will be measured by a combination of user engagement, learning effectiveness, and platform performance metrics.

- **User Engagement & Adoption:**
  - **Number of Active Users (Daily/Weekly/Monthly):** Tracks the overall user base and its growth over time.
  - **Session Duration:** Average time spent per user session, indicating engagement with the content.

- **Quiz Completion Rate:** Percentage of users who complete quizzes they start for a given topic.
- **Feature Adoption Rate:** Usage frequency of key features like the chatbot, feedback submission, and topic switching.
- **User Retention Rate:** Percentage of users returning to the platform after their initial sessions or over a defined period (e.g., 1-month, 3-month retention).

- **Learning Effectiveness:**
  - **Average Improvement in Difficulty Level:** Tracking how quickly users progress to higher difficulty levels within topics.
  - **Success Rate in Remedial Quizzes:** Percentage of users who successfully pass the mastery check question after completing remedial quizzes, indicating effective weakness remediation.
  - **Reduction in Incorrect Answers on Specific Concepts Over Time:** Analyzing if repeated exposure and explanations lead to better understanding of previously difficult concepts for the user base.
  - **User-Reported Satisfaction (via Feedback):** Qualitative and quantitative feedback on question quality, explanation clarity, and overall learning experience.
  - **Correlation between Platform Usage and External Academic Performance (Long-term, if data available):** Exploring potential links between sustained platform use and improvements in students' actual course grades or exam scores (this is an aspirational metric requiring external data correlation).

- **Platform Performance & Stability:**
  - **System Uptime:** Percentage of time the platform is operational and accessible.
  - **Average Page Load Time:** Ensuring a fast and responsive user experience.
  - **LLM API Response Times & Error Rates:** Monitoring the performance and reliability of the integrated LLM services.
  - **User-Reported Technical Issues:** Number and severity of bugs or technical problems reported by users.

- **Content Quality (LLM-Generated):**
  - **Feedback Scores on Question Relevance and Explanation Clarity:** Aggregated scores from user feedback on specific questions and explanations.
  - **Internal Review Metrics:** Periodic internal audits of LLM-generated content for accuracy, relevance, and pedagogical soundness, especially for new topics or LLM model updates.