**Project Report on :**

**Problem Statement : 03**

# AI-Powered Personal Tutor: A Scalable, Adaptive Learning System for Enhanced Student Engagement

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**AI-Powered Tutor System - Comprehensive Project Report**

## 1. Introduction :

The AI-Powered Personal Tutor System is an innovative, scalable learning platform designed to provide personalized education through artificial intelligence. Developed as a web-based application, it addresses critical gaps in traditional education by offering adaptive learning paths, real-time AI assistance, and secure user authentication.

### Problem Statement

Traditional education systems often fail to provide individualized attention, leading to:
**Fixed learning paces** that don't accommodate all students.
Limited feedback mechanisms , leaving learners uncertain about progress.
No real-time assistance for doubts outside classroom hours.

Our solution bridges these gaps with:
1. **Adaptive Learning** : Customized course recommendations based on performance.
2**. AI-Powered Tutoring** : Instant doubt resolution via chat.
3. **Progress Tracking** : Visual analytics for courses, assignments, and quizzes.
4. **Secure Access** : Encrypted authentication protecting user data.

## 2. Team Structure & Contributions

Team Member

**Manish Kumar M (Leader)** : Backend & AI Integration , Designed system architecture Integrated Ollama/Mistral AI based on training data and also Implemented Flask API endpoints

**Shreya Pandey** : Frontend Developer , Built responsive UI (HTML/CSS/JS) such as Theme toggling (dark/light mode) Dynamic course rendering and more.

**Ritesh Prajapati** : Course Content Developer , Created course materials (AI, ML, Data Science) Designed quizzes & assignments and also Integrated reference resources.

**Syeda Bushra** : Documentation & Testing , Prepared project reports and Recorded demo videos along with Conducting user test

## 3. System Architecture

### Frontend

Technologies : HTML5, CSS3, JavaScript (Bootstrap for responsiveness).

Key Pages:
Login/Register : Secure authentication with password hashing.
Dashboard : Progress overview, enrolled courses, and assignments.
Classroom : Interactive lessons with embedded AI chat and AI classmate.

Courses : Filterable catalog (AI, ML, Data Science).

**Backend**
Framework : Flask (Python) for API endpoints.
AI Engine : Ollama with Mistral (7B parameter LLM) for:
Real-time Q&A (`/ask` endpoint) in selected course based on RAG.
Test/assignment generation.
Data Storage : localStorage for user data  storage demonstration (simulated database), later used data base (sqlite) to save the records of user.

**Data Flow**
1. User Input → Flask API → Trained Ollama AI → Streaming Response → Frontend.

**4. Key Features**

**Personalized Learning**
Adaptive Paths : Recommends courses based on quiz performance.
Self-Paced Progress : Users control learning speed.
Real-Time AI Tutor and AI classmate

**Context-Aware Responses:**

```
def get_course_context_response(question, course):
    prompt = f"Answer this question about {course}: {question}"
    return chat_with_ollama(prompt)
```

Streaming Replies : Mimics human-like interaction.

**Progress Tracking**

Visual Analytics :

```
function updateProgress(course, progress) {
    const allProgress = JSON.parse(localStorage.getItem("courseProgress")) || {};
    allProgress[course] = progress;
    localStorage.setItem("courseProgress", JSON.stringify(allProgress));
}
```

Assignment Status : Submitted/completed indicators.

**Secure Authentication**

Password Hashing : SHA-512 with salt.
Session Management : JWT tokens (simulated via `localStorage`).

**5. Technical Implementation**

**Frontend (Shreya Pandey)**

**Dynamic UI** :

- Theme toggling (CSS variables).
- Course cards with hover effects.
- learning tips with dynamic messages
- Homework section aligned with selected course
- Course completion and clear section

**Interactive Elements** :

- Quiz auto-grading.
- Assignment submission forms.

**Backend & AI (Manish Kumar M) :**

- Data preparation for RAG model
- Course meta data preparation in json formate
- Local server set up to route prompts and response from front end to backend

- **Flask API**:

```
@app.route("/ask", methods=["GET"])
def ask_ai():
    question = request.args.get("question")
    response = ollama.generate(question)
    return Response(stream_with_context(response))
```

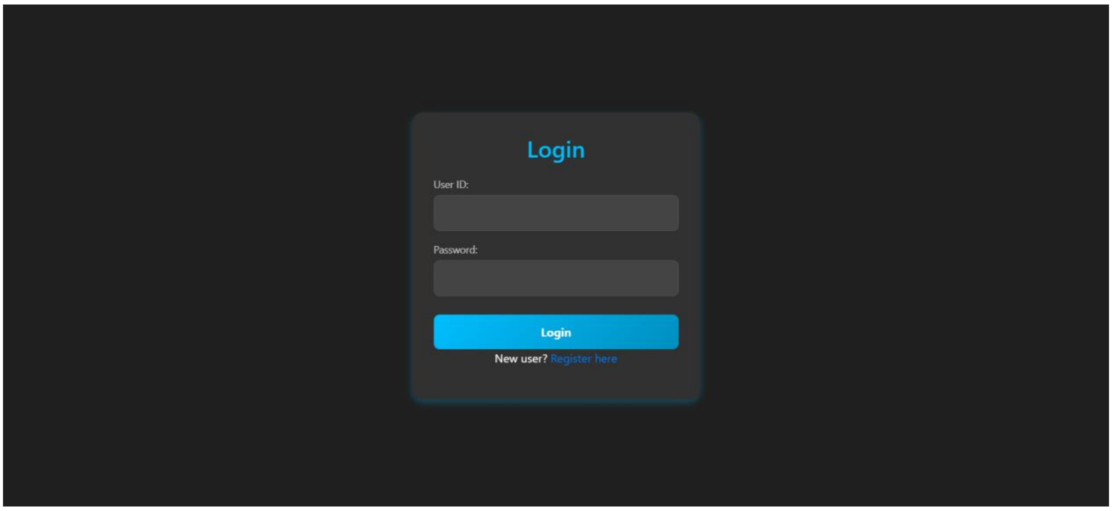
- Prompt Engineering for fintued response
- AI Prompts : Customized for course context.

**Course Content (Ritesh Prajapati) :**

- **Structured Modules**:
  - **Introduction to AI**: History, ethics, applications , advantages and types in genreal.
  - **Machine Learning**: Algorithms, case studies.
  - **Advance concepts of AI :** delving deep into Advance AI tiopics
- **Quizzes** : MCQs with instant feedback.
- **Assignments :** Dynamic assignment for selected courses

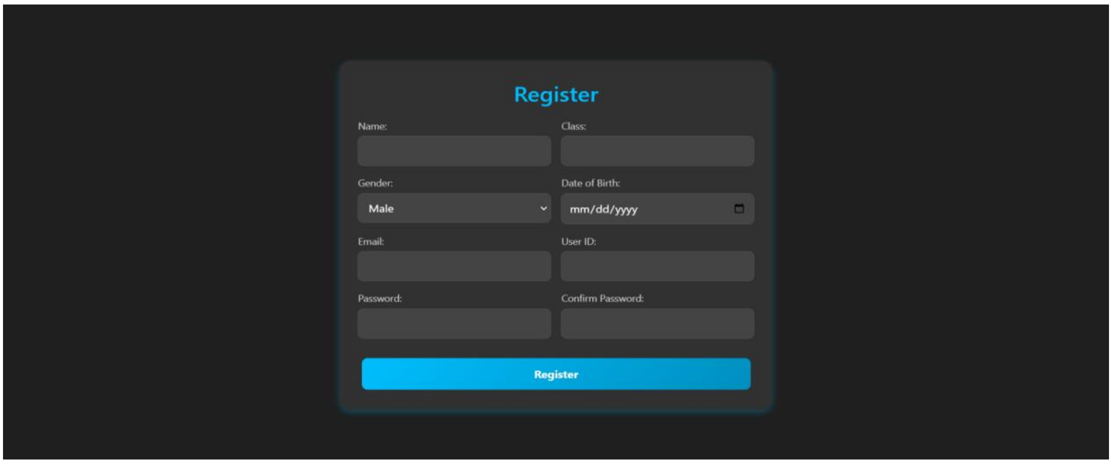
## 6. Highlights of our project and discription:

### - Login Pgae



A basic and clean UI for secure User Login . For uninterupted demonstration we have used Local storage but also we have another option with sqlite , which  become a top notch

### - Registration Page

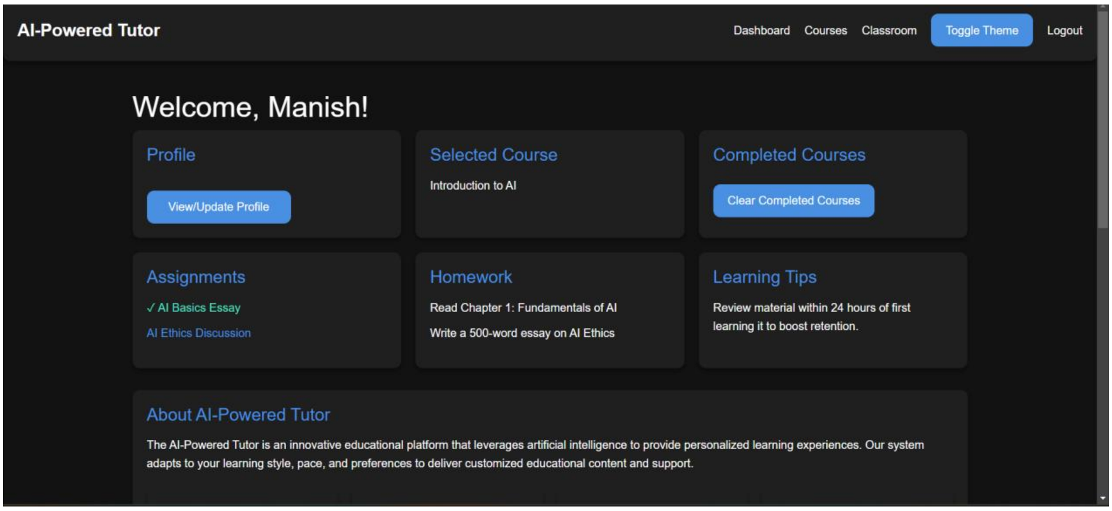


Gender: Male

Another clean and eligant UI for user registration containg necessary fields like Name , Class Gender , DOB , email , Uid , and password**.**

Here we have implement logics to check If the user already exist , or check the duplication if Uid and emails field.

**-User Home Page/ Dashboard**



Welcome, Manish!

Profile

Selected Course

Introduction to AI

Completed Courses

Assignments

✓ AI Basics Essay

AI Ethics Discussion

Homework

Read Chapter 1: Fundamentals of AI

Write a 500-word essay on AI Ethics

Learning Tips

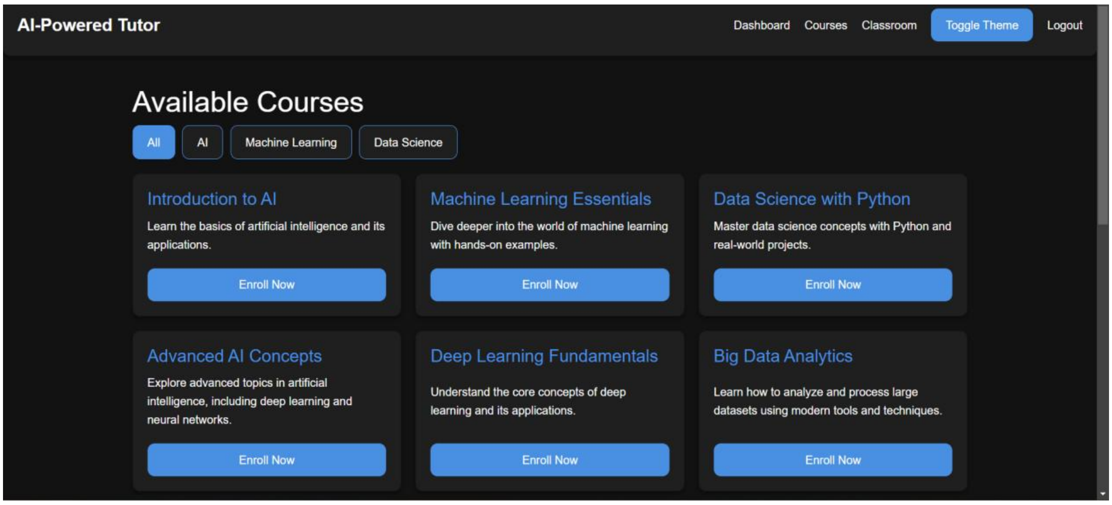
Review material within 24 hours of first learning it to boost retention.

About AI-Powered Tutor

The AI-Powered Tutor is an innovative educational platform that leverages artificial intelligence to provide personalized learning experiences. Our system adapts to your learning style, pace, and preferences to deliver customized educational content and support.

Dashboard greet with user name , and contains several dynamic sections such as profile for any updates , selected sourse section that display the current course , and once the course is completed it gets moved to completed course section. Cards of Assignment , home works changes dynamically acording to slection of course , and a helpful motivating card for tips to learners.

**-Course Page**



Available Courses

Introduction to AI

Learn the basics of artificial intelligence and its applications.

Machine Learning Essentials

Dive deeper into the world of machine learning with hands-on examples.

Data Science with Python

Master data science concepts with Python and real-world projects.

Advanced AI Concepts

Explore advanced topics in artificial intelligence, including deep learning and neural networks.

Deep Learning Fundamentals

Understand the core concepts of deep learning and its applications.

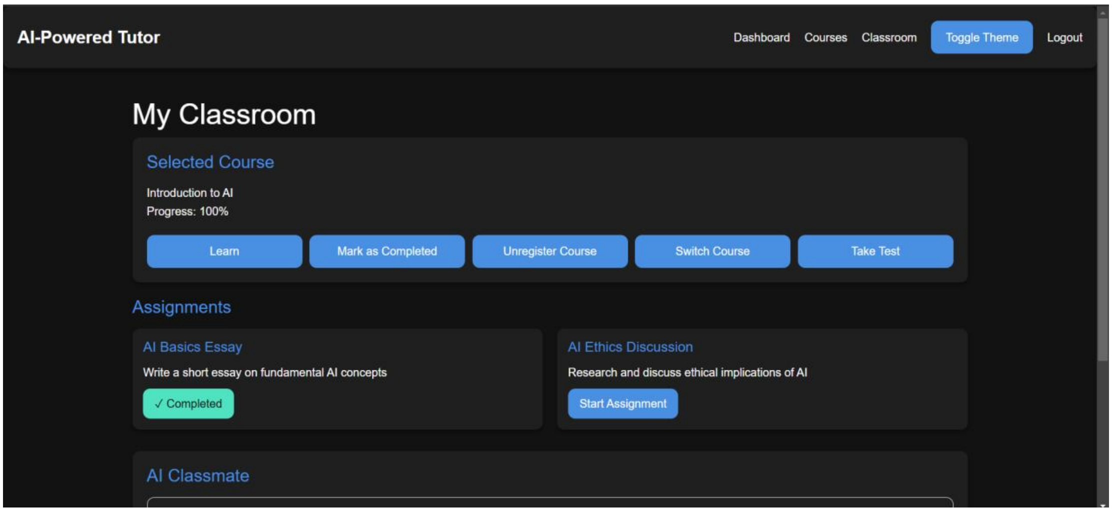
Big Data Analytics

Learn how to analyze and process large datasets using modern tools and techniques.

This page has a buch of catalogs specifying the group of courses that we have added. Such as AI , Machine Learning and Data science for this project and demonstration.

Since here only few courses are developed in detail and rest are in progress , so if user clicks on those course , we still manage that by displaying a **course in developent** message to user

### -Classroom Page



My Classroom

Selected Course

Introduction to AI

Progress: 100%

Assignments

AI Basics Essay

Write a short essay on fundamental AI concepts

✓ Completed

AI Ethics Discussion

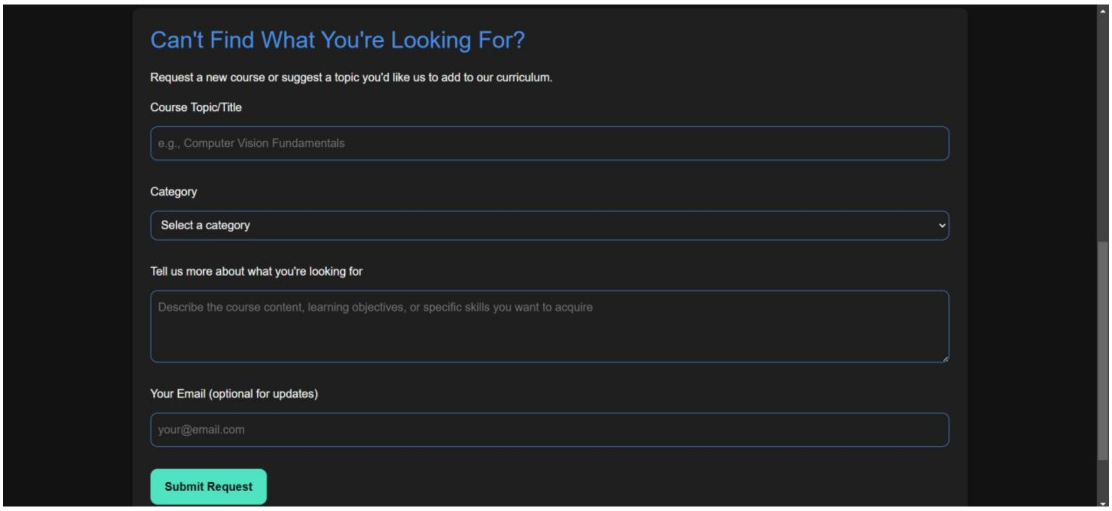
Research and discuss ethical implications of AI

AI Classmate

This is the page where user learns and access to materials of selected course.
We made sure that we don't miss out any basic and important functionalities that may hamper the learning and evaluating experience.

There are handy navigations at one place such as learn , completion , unregister course if not interested and them switch directly to course page form next button… and if course selected they might take the test and assignment at any time.

### -User course request



Can't Find What You're Looking For?

Request a new course or suggest a topic you'd like us to add to our curriculum.

Course Topic/Title

e.g., Computer Vision Fundamentals

Category

Select a category

Tell us more about what you're looking for

Describe the course content, learning objectives, or specific skills you want to acquire

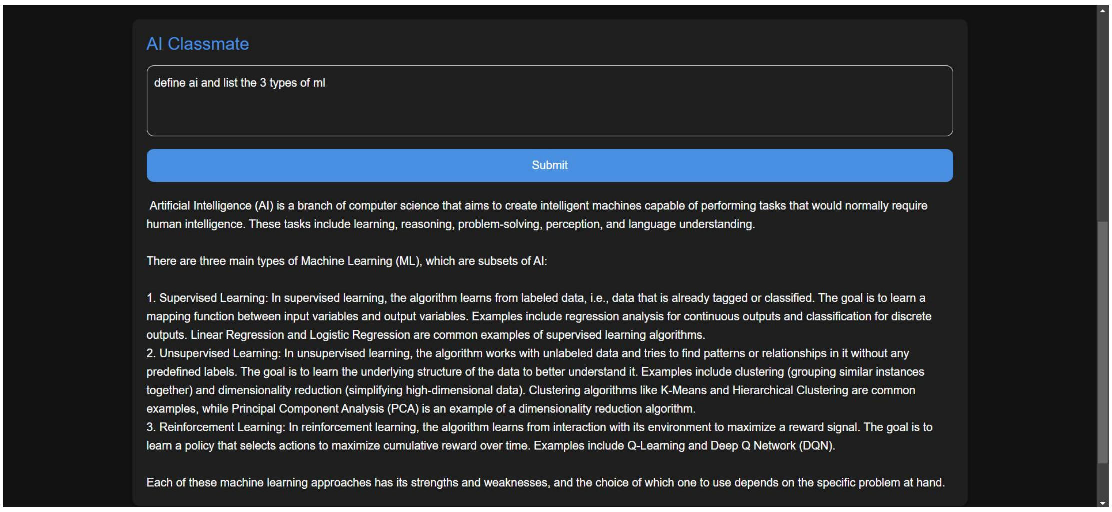
Your Email (optional for updates)

your@email.com

Also we made sure to add another functionality where if user doesn't find course of its interest , they still have the option to request a course to be developed.

The field inside this card make sure to collect enough information regarding the requested course that may ease the process of course developers

**- AI Classmate**



AI Classmate

define ai and list the 3 types of ml

Artificial Intelligence (AI) is a branch of computer science that aims to create intelligent machines capable of performing tasks that would normally require human intelligence. These tasks include learning, reasoning, problem-solving, perception, and language understanding.

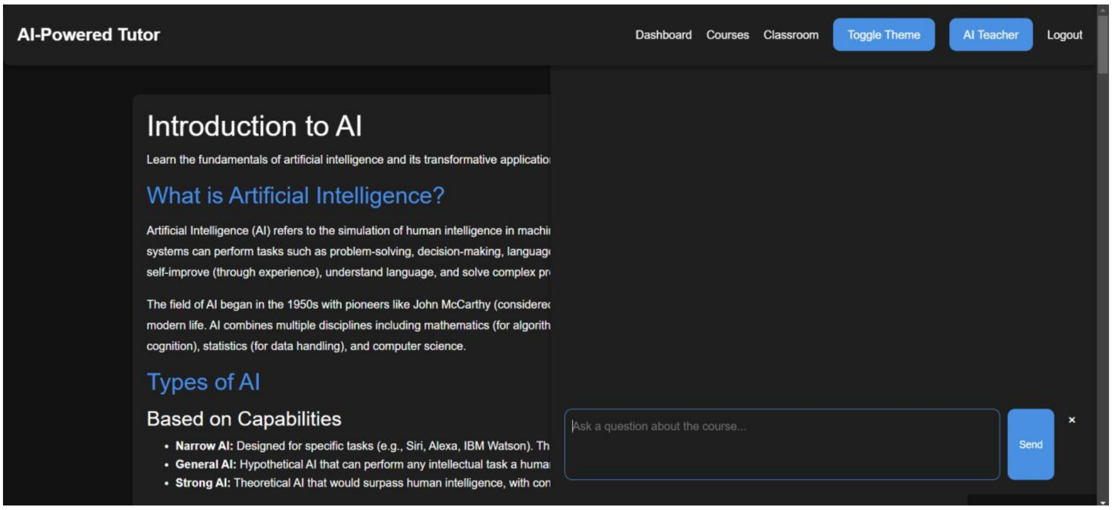
There are three main types of Machine Learning (ML), which are subsets of AI:

1. Supervised Learning: In supervised learning, the algorithm learns from labeled data, i.e., data that is already tagged or classified. The goal is to learn a mapping function between input variables and output variables. Examples include regression analysis for continuous outputs and classification for discrete outputs. Linear Regression and Logistic Regression are common examples of supervised learning algorithms.
2. Unsupervised Learning: In unsupervised learning, the algorithm works with unlabeled data and tries to find patterns or relationships in it without any predefined labels. The goal is to learn the underlying structure of the data to better understand it. Examples include clustering (grouping similar instances together) and dimensionality reduction (simplifying high-dimensional data). Clustering algorithms like K-Means and Hierarchical Clustering are common examples, while Principal Component Analysis (PCA) is an example of a dimensionality reduction algorithm.
3. Reinforcement Learning: In reinforcement learning, the algorithm learns from interaction with its environment to maximize a reward signal. The goal is to learn a policy that selects actions to maximize cumulative reward over time. Examples include Q-Learning and Deep Q Network (DQN).

Each of these machine learning approaches has its strengths and weaknesses, and the choice of which one to use depends on the specific problem at hand.

This project also aims to devlop a good intereative environment where leaners must not get bored in the course completion journey , thus we have added a classmate powerd by AI for user , where the learners can chat , learn and stay updated with new tends and tech with their conversation and queries.

**-AI Teacher :**



Introduction to AI

Learn the fundamentals of artificial intelligence and its transformative applicatio

What is Artificial Intelligence?

Artificial Intelligence (AI) refers to the simulation of human intelligence in machi systems can perform tasks such as problem-solving, decision-making, languag self-improve (through experience), understand language, and solve complex pr

The field of AI began in the 1950s with pioneers like John McCarthy (considere modern life. AI combines multiple disciplines including mathematics (for algorith cognition), statistics (for data handling), and computer science.

Types of AI

Based on Capabilities

- **Narrow AI:** Designed for specific tasks (e.g., Siri, Alexa, IBM Watson). Th
- **General AI:** Hypothetical AI that can perform any intellectual task a huma
- **Strong AI:** Theoretical AI that would surpass human intelligence, with con

While we have added an AI powered Classmate for general converastion , But when user is in learning page , we made sure that to another AI assisatnt teacher which basically trained on that perticular course , leading to more catered reposnse on course related queries , this model is been trianed using models of rag and mistral AI for more appropriate responses.

## 7. How the Project Works

The **AI-Powered Personal Tutor System** is a comprehensive web-based learning platform designed to deliver personalized education through artificial intelligence. The system begins with a **secure authentication** process, where users register or log in with encrypted credentials, ensuring data privacy. Upon accessing the **dashboard**, students view their enrolled courses, progress metrics, and upcoming assignments. The **course selection** feature allows users to browse and filter subjects (AI, ML, Data Science) and enroll in self-paced learning paths.

Within the **classroom interface**, students engage with structured course content, including interactive lessons, quizzes, and reference materials. The **AI Teacher**, powered by **Retrieval-Augmented Generation (RAG)**, provides real-time, context-aware assistance by retrieving answers from curated course materials, ensuring accuracy. Meanwhile, the **AI Classmate** offers general study support, such as motivation tips and productivity advice, without relying on course-specific data.

Progress is tracked via **visual indicators**, including completion percentages and achievement badges. The **assignment system** lets users submit tasks, receive AI-generated feedback, and monitor grading status. Additionally, the platform recommends **adaptive learning resources** (videos, articles, quizzes) based on performance.

By combining **personalized learning**, **AI-driven tutoring**, and **secure data management**, the system creates a dynamic, student-centric educational experience that adapts to individual needs.

## 8. Libraries and Technologies used :

**Bootstrap 4.5 : For responsive UI**
**JavaScript ES6+ : For core logic and dynamic implementation**
**Flask : for creating local api end points**
**Requests : For handling API call requests**
**JSON : Used for data seialization for API responses**
**Ollama : Inorder to host Mistral model**
**FAISS : Used in building rag model for vector database initialisation**
**Crypto-JS : For password hashing**
**Web Storage API : for Local storages**
**And more…**

## 9. Conclusion :

The **AI-Powered Tutor System** successfully demonstrates:
✔ **Secure authentication** by sqlite and local storage(client side)

✔ **Personalized learning** through adaptive courses.
✔ **Instant AI assistance**  via Mistral LLM and RAG based model.
✔ **Robust progress tracking** with visual analytics.

**Impact** : This prototype lays the foundation for scalable, AI-driven education tools that can democratize access to personalized learning.

**Appendix :**

- **GitHub Repo** : [Link]
- **Demo Video** : [Link]

**Submitted on** : 28|March|2025