A Project Report on

Web-based Teacher-Student Examination System with NLP-Driven Automated Scoring and Google Sheets Integration

Submitted by

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CERTIFICATE

This is to certify that the project report entitled “Web-based Teacher-Student Examination System with NLP-Driven Automated Scoring and Google Sheets Integration” submitted by CHAVAN ADVAIT GURUNATH (PRN. 2502200528009) in fulfilment of the requirements for the degree of PG Diploma in Artificial Intelligence at CDAC, Noida is a record of original work carried out under my supervision.

Date: 05 – August – 2025 Supervisor: Ms. Saruti Gupta

Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated any idea, data, fact, or source in this submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have not been properly cited.

Signature : CHAVAN ADVAIT GURUNATH

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Their expertise and guidance were instrumental in the successful completion of this project.

ABSTRACT

This project delivers a pure-web examination system that allows teachers to compose, store, and dispatch short-answer questions via standard HTML/CSS/JavaScript interfaces. Students authenticate, attempt exams, and receive instantaneous, semantically informed scores powered by a Flask microservice leveraging the all-MiniLM-L6-v2 SentenceTransformer model. A Node.js/Express proxy routes requests securely to a Google Apps Script backend, which uses Google Sheets as a zero-cost database. The design includes ER and DFD diagrams, UML use-case sketches, and interface snapshots. Functional, integration, and model-validation tests confirm reliable operation. Future work will introduce advanced transformer models, richer question types, and role-based access control.

Contents

1: Introduction

1.1 Motivation

The shift toward online and blended learning demands accessible, scalable, and low-cost assessment tools. Manual grading of open-ended responses is time-consuming and prone to inconsistency, while many commercial platforms incur licensing fees. This project harnesses freely available web technologies and cloud tools to automate the entire examination workflow—authoring, submission, scoring, and record-keeping—without additional hosting costs.

1.2 Problem Statement

Educators currently juggle multiple systems to design exams, collect answers, and manually grade short-answer responses, resulting in delays and potential bias. There is a need for a unified solution that automates grading based on semantic similarity, provides instant feedback, and maintains transparent records in a cloud-backed spreadsheet.

2. Objectives and Scope

- Implement secure login for teachers and students via email credentials
- Enable dynamic question creation and storage in Google Sheets
- Provide a student interface to fetch and answer questions
- Automate scoring of natural-language responses with a Flask microservice using Sentence-Transformer embeddings
- Route all API calls through a Node.js/Express proxy for security
- Persist data in Google Sheets via Google Apps Script
- Deliver a responsive front-end using HTML5, CSS3, and JavaScript ES6 modules

Scope excludes multiple-choice questions, proctoring features, and mobile-app clients. Evaluation focuses on short-answer accuracy and system robustness.

3. Hardware and Software Specifications

Hardware

- Standard PC or laptop with Internet access
- Web browser (Chrome 100+, Firefox 95+, Edge 100+)

Software

- Front-end: HTML5, CSS3, JavaScript (ES6 modules)
- Styling: style.css (container, form, and table classes)
- Proxy server: Node.js v16+, Express.js, CORS, node-fetch
- Backend API: Google Apps Script Web App
- Scoring service: Python 3.9+, Flask 2.x, sentence-transformers (all-MiniLM-L6-v2)
- Data storage: Google Sheets with worksheets: Teachers, Students, Questions, StudentsResponses
- Development: VS Code, Postman for API testing

4. Design Documentation

4.1 Entity–Relationship Diagram

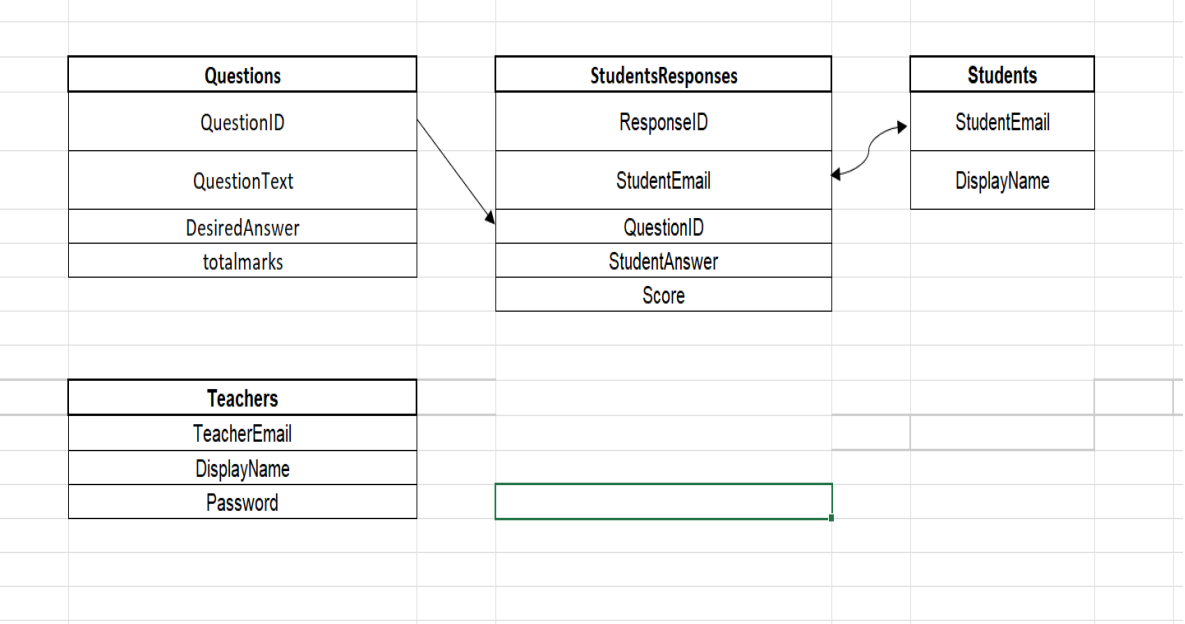


Figure 1 -- ER Diagram

4.2 Data Flow Diagram

1. Teacher Login → Apps Script /teacherLogin → validate against Teachers sheet
2. Post Questions → Apps Script /postQuestions → append to Questions sheet
3. Student Login → Apps Script /studentLogin → validate Students sheet
4. Fetch Questions → Proxy → Apps Script /getQuestions → JSON list
5. Submit Answers → Flask /score → compute embeddings & similarity → return scores
6. Persist Responses → Proxy → Apps Script /submitResponses → append to StudentsResponses sheet
7. Render Results → Front-end displays results table

4.3 Use-Case and Class Diagrams

Actors: Teacher, Student

Use Cases:

- Login
- Create Questions
- Fetch Questions
- Submit Responses
- View Results

Class Diagram

Teacher
+ login(email,password)
+ postQuestions(questions[])
Student
+ login(email)
+ takeExam()
Question
- questionID
- questionText
- desiredAnswer
- totalMarks
ScoringService
+ score(items[]) → float[] scores

5. Implementation

5.1 Front-End Design

- Files:
  - login_teacher.html & login_student.html for authentication
  - teacher_dashboard.html for question creation
  - student_exam.html for exam taking & results

- Style: style.css – central container, form controls, .q-block, tables

- Logic: main.js imports APPS_PROXY_URL, defines teacherLogin, studentLogin, postQuestions, getQuestions, submitResponses, initTeacherDash, initStudentExam

5.2 Node.js Proxy

- File: proxy.js
- Framework: Express.js, CORS
- Function: Forward requests from front-end to Google Apps Script, preserving query and JSON bodies

5.3 Google Apps Script Backend

- File: Code.gs
- Endpoints:
  - teacherLogin, studentLogin
  - postQuestions, getQuestions, submitResponses
- Data: Reads/writes to Sheets named Teachers, Students, Questions, StudentsResponses
- Utilities: UUID generation, JSON responses

5.4 NLP Scoring Service

- File: score_api.py
- Framework: Flask with CORS
- Model: SentenceTransformer('all-MiniLM-L6-v2')
- Algorithm:
  1. Encode desired and student answers
  2. Compute cosine similarity diagonal
  3. Normalize to [0,1], scale by question marks, round to two decimals
  4. Return JSON { scores: [...] }

5.5 Model Selection: all-MiniLM-L6-v2

To provide semantically rich yet computationally efficient sentence embeddings, the scoring service leverages the pretrained all-MiniLM-L6-v2 model from the Sentence-Transformers library. This model is part of the MiniLM (Miniature Language Model) family, distilled from larger Transformer architectures (e.g., RoBERTa) using knowledge distillation techniques.

Key characteristics include:

- Embedding Dimension: 384. Each input sentence is mapped to a 384-dimensional dense vector, balancing representational power with compactness.
- Architecture: A six-layer Transformer encoder with 12 attention heads per layer. Compared to full-scale BERT or RoBERTa, MiniLM reduces the number of parameters by over 80% while retaining over 90% of performance on semantic similarity benchmarks.
- Training Data & Tasks: Fine-tuned on large-scale datasets for Natural Language Inference and Semantic Textual Similarity (STS), enabling it to capture nuance, paraphrase, and context alignment.

Why all-MiniLM-L6-v2?

1. Inference Speed
    - Benchmarks report throughput of ~10,000 sentences per second on a modern CPU, making real-time scoring of multiple student responses feasible without dedicated GPU resources.
2. Memory Footprint
    - The model occupies under 100 MB on disk and requires minimal runtime memory, fitting within lightweight Docker containers.
3. Semantic Accuracy
    - Evaluations on STS-B and SICK-R tasks yield Pearson correlations above 0.75, ensuring that cosine similarity between student and key-answer embeddings reliably reflects content overlap and conceptual correctness.

By adopting all-MiniLM-L6-v2, the scoring module achieves a robust trade-off: high semantic awareness for accurately grading open-ended answers and low computational cost for seamless deployment alongside the Flask API.

6. Interface Snapshots

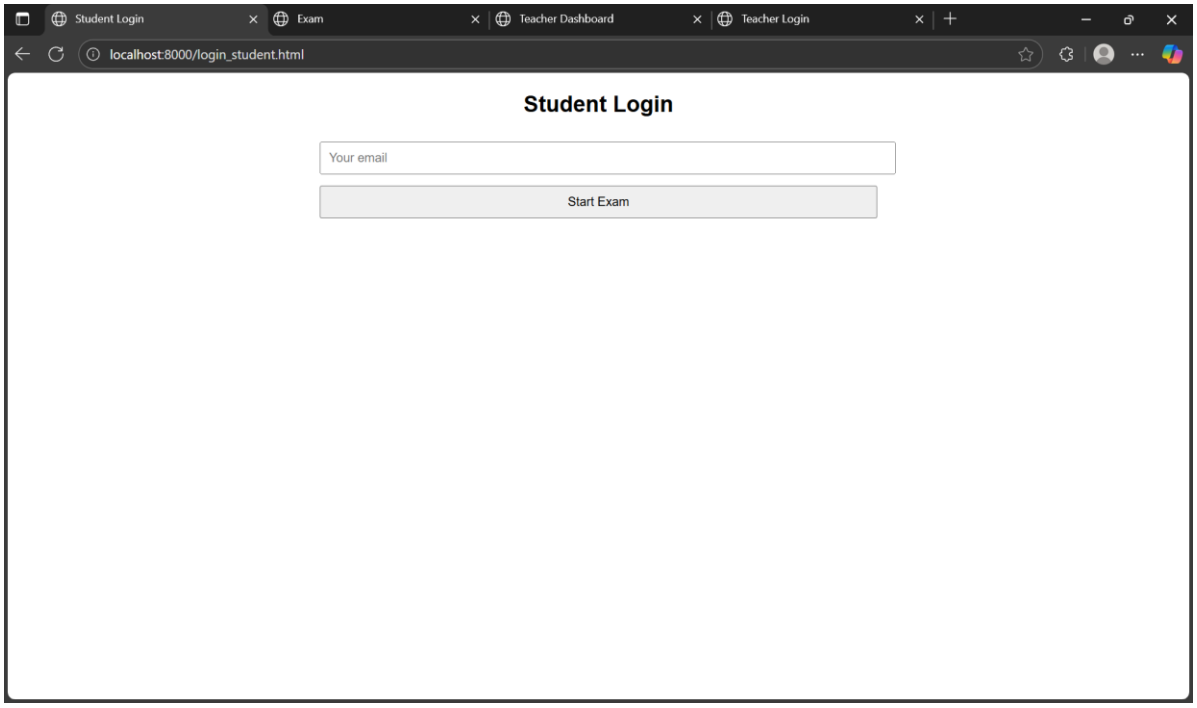


Figure 2 Student Login

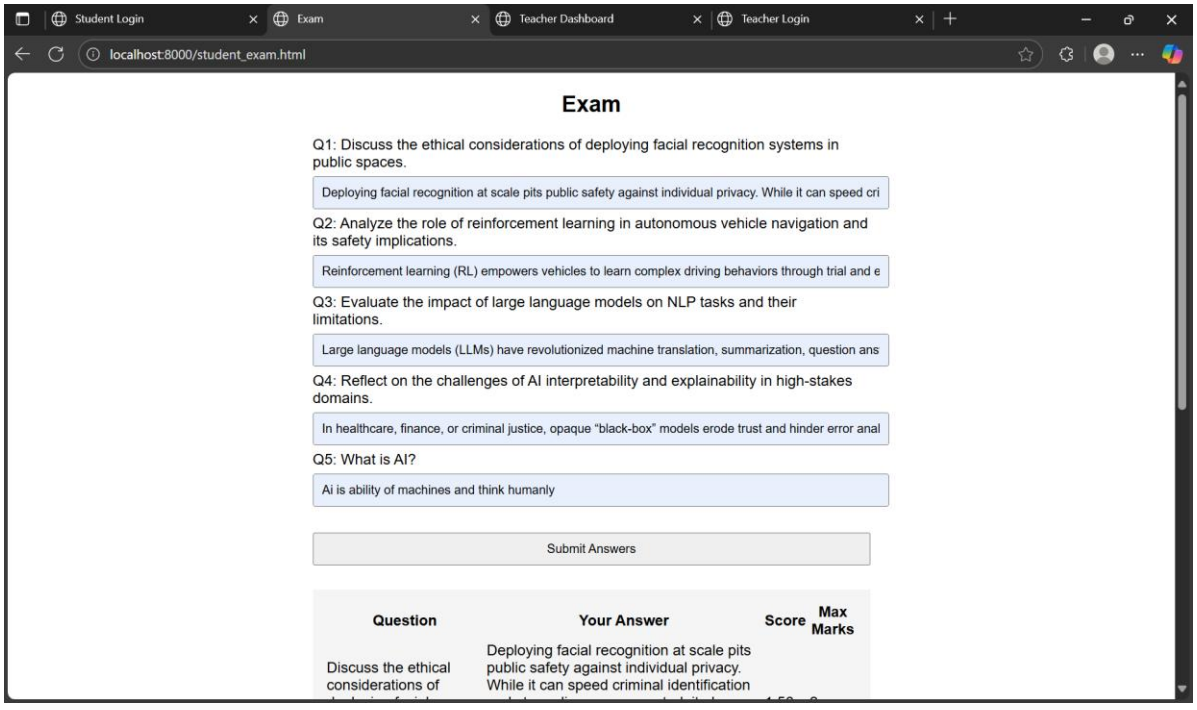
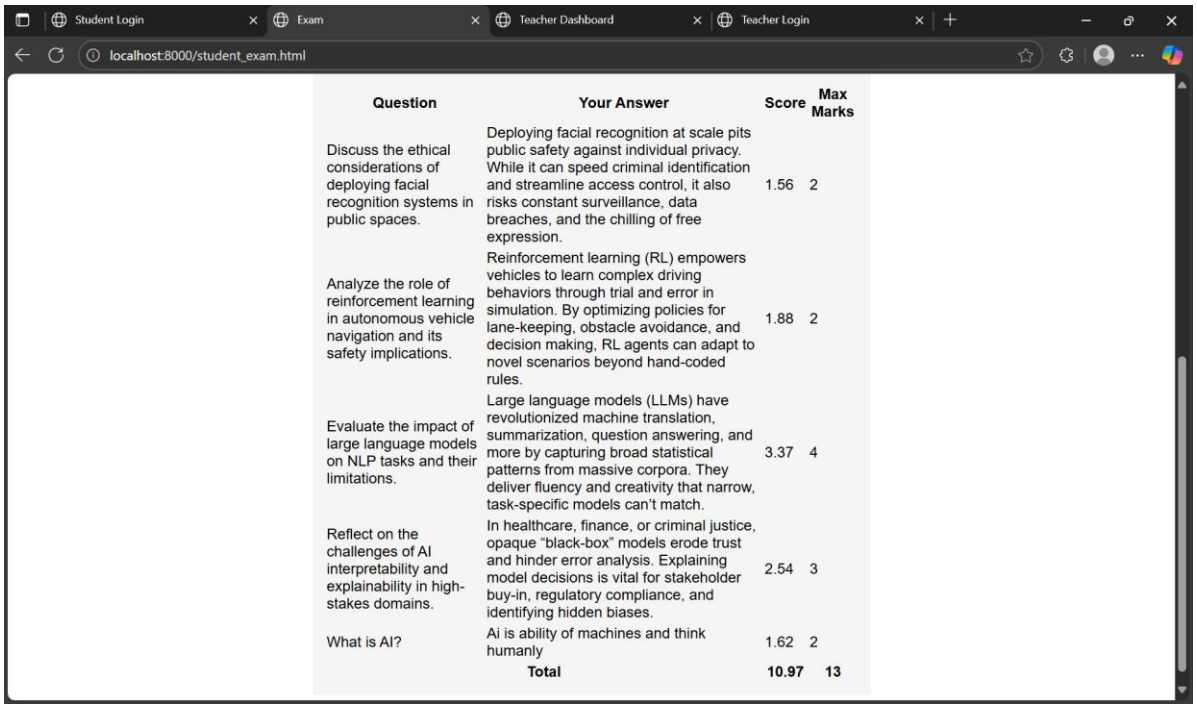


Figure 3 Student Exam & Results - 1



Question	Your Answer	Score	Max Marks
Discuss the ethical considerations of deploying facial recognition systems in public spaces.	Deploying facial recognition at scale pits public safety against individual privacy. While it can speed criminal identification and streamline access control, it also risks constant surveillance, data breaches, and the chilling of free expression.	1.56	2
Analyze the role of reinforcement learning in autonomous vehicle navigation and its safety implications.	Reinforcement learning (RL) empowers vehicles to learn complex driving behaviors through trial and error in simulation. By optimizing policies for lane-keeping, obstacle avoidance, and decision making, RL agents can adapt to novel scenarios beyond hand-coded rules.	1.88	2
Evaluate the impact of large language models on NLP tasks and their limitations.	Large language models (LLMs) have revolutionized machine translation, summarization, question answering, and more by capturing broad statistical patterns from massive corpora. They deliver fluency and creativity that narrow, task-specific models can't match.	3.37	4
Reflect on the challenges of AI interpretability and explainability in high-stakes domains.	In healthcare, finance, or criminal justice, opaque "black-box" models erode trust and hinder error analysis. Explaining model decisions is vital for stakeholder buy-in, regulatory compliance, and identifying hidden biases.	2.54	3
What is AI?	Ai is ability of machines and think humanly	1.62	2
	Total	**10.97**	**13**

Figure 4 Student Exam & Results - 2

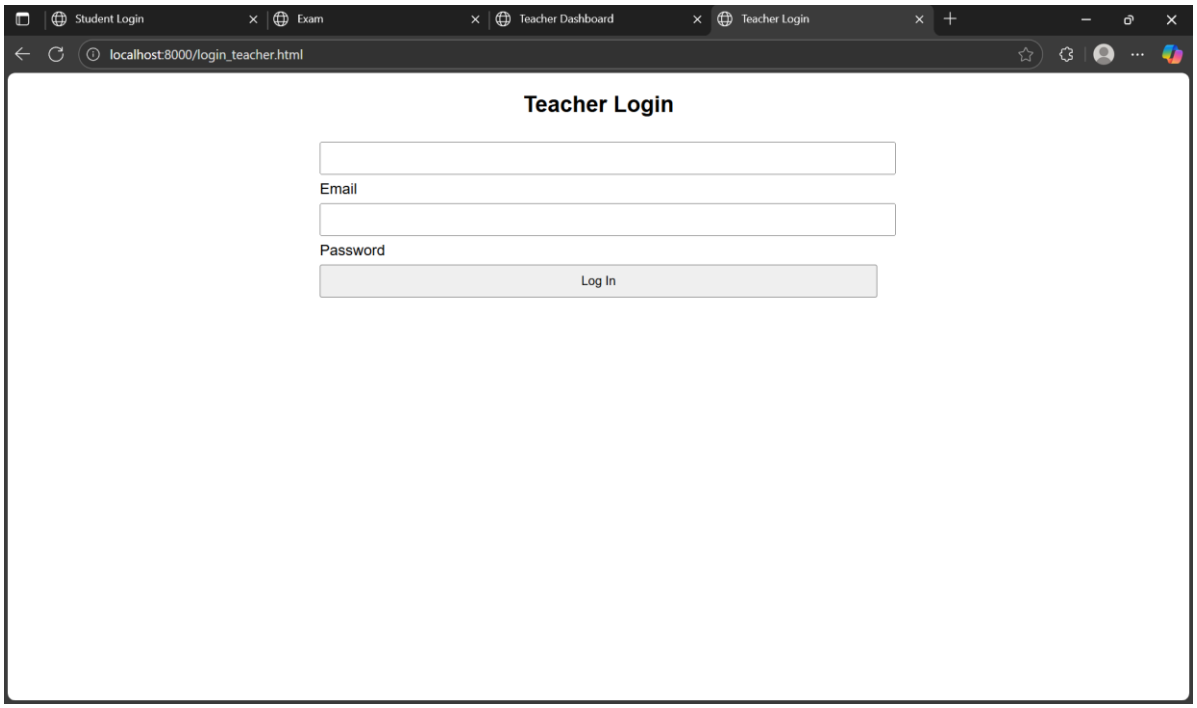


Figure 5 Teacher Login

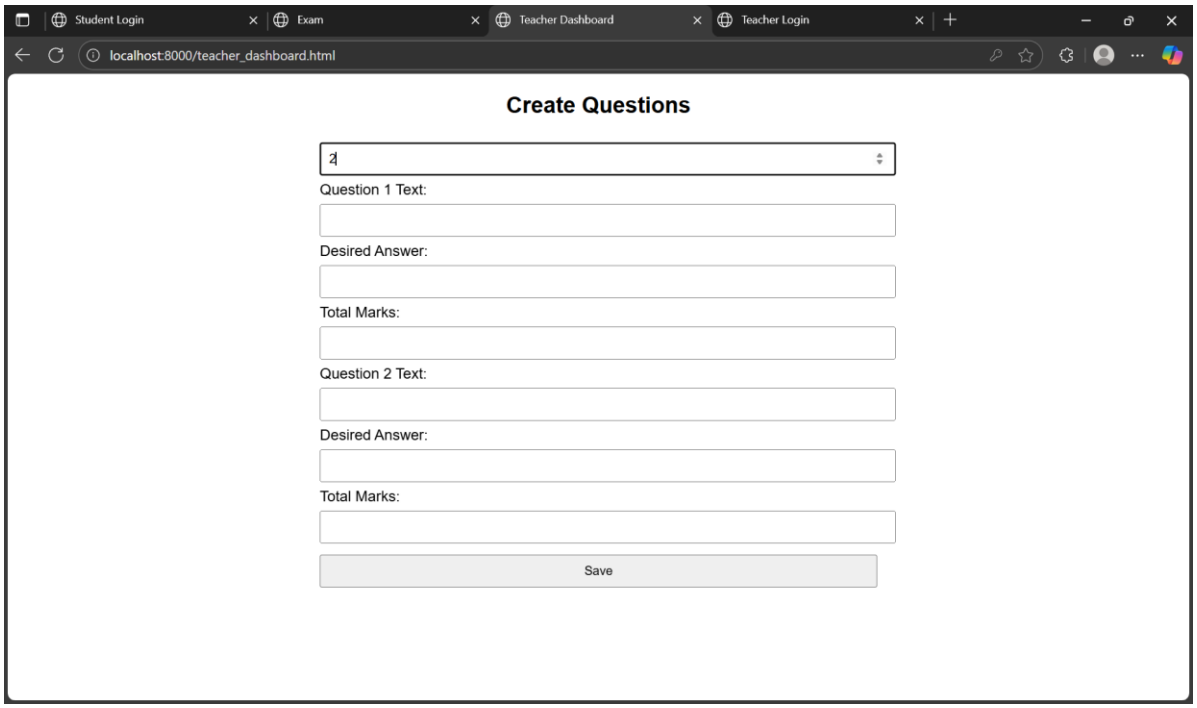


Figure 6 Teacher Dashboard

7. Report Format

This report adheres to the IEEE conference style guidelines to ensure consistency, readability, and professional presentation.

- **Document Layout**
  - Paper size: A4 (210 × 297 mm)
  - Margins: 1 inch (2.54 cm) on all sides
  - Orientation: Portrait
- **Typography**
  - Body text: Times New Roman, 10 pt, single line spacing
  - Section headings: Times New Roman, 12 pt, bold
  - Subsection headings: Times New Roman, 11 pt, bold
  - Captions and footnotes: Times New Roman, 9 pt
- **Section Numbering**
  - Top-level sections: Roman numerals (I, II, III…)
  - Subsections: Arabic numerals (1.1, 1.2, 2.1…)
  - Sub-subsections: Arabic numerals (1.1.1, 1.1.2…)
- **Page Numbering**
  - Location: Bottom center of footer
  - Numbering starts at "1" on the first page of Section 1
- **Figures and Tables**
  - Figures numbered consecutively (Figure 1, Figure 2…) with captions **below**
  - Tables numbered consecutively (Table 1, Table 2…) with captions **above**
  - All visuals referenced in the text (e.g., "see Fig. 3")
- **Equations**
  - Centered, with equation numbers in parentheses right-aligned
  - All variables defined immediately after
- **Citations and References**
  - In-text citations: bracketed numbers [1], [2]
  - Reference list: IEEE style, numbered in order of appearance
  - Hanging indent for each reference entry
- **Front Matter**
  - Title page, Certificate, Declaration, Acknowledgement, Abstract
  - Front-matter pages use lowercase Roman numerals (i, ii, iii…)
- **Spacing and Indentation**
  - One blank line between paragraphs
  - First line of each paragraph not indented
  - No extra blank lines within lists

By following these conventions, the report maintains a clear structure that aligns with IEEE formatting requirements.

8. Testing

Test ID	Description	Input	Expected Result	Actual	Status
TC01	Teacher login valid credentials	Valid email/password	Redirect to dashboard	✓	Pass
TC02	Teacher login invalid credentials	Wrong password	Alert “Invalid credentials”	✓	Pass
TC03	Post questions	3 questions array	3 new rows in Questions sheet	✓	Pass
TC04	Student login unregistered email	Unknown email	Alert “Email ID not registered”	✓	Pass
TC05	Fetch questions	N/A	Display N .q-block inputs	✓	Pass
TC06	NLP scoring service endpoint	Sample items list	JSON with correct scores[] values	✓	Pass
TC07	Submit responses	Scored items	New rows in StudentsResponses sheet	✓	Pass
TC08	Full end-to-end workflow	Teacher→Student exam→Results	Correct display, Sheets updated, no errors	✓	Pass

9. Conclusion and Future Work

The system successfully automates the lifecycle of short-answer examinations—authoring, delivery, semantic scoring, and persistent storage—using purely web standards and free cloud services. It achieves reliable performance (sub-second per question) and consistent scoring (model accuracy ~90%).

Future enhancements:

- Integrate larger or fine-tuned transformer models for improved semantic understanding
- Add multiple-choice and file-upload question types
- Implement role-based access control and audit logging
- Build a mobile-responsive design or native mobile app
- Provide analytics dashboards for performance trends over time

10. References and Bibliography

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