CUSTOMIZED LEARNING ASSESSMENT GENERATION

Team 20

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PROBLEM STATEMENT

- With the implementation of National Education Policy 2020, and shift of focus towards holistic education, our traditional textbooks, teaching methods and assessment strategies are becoming obsolete.
- The teaching methods need to incorporate external factors like background, students' interests, practical application, moral responsibility in addition to the course content to ensure a holistic understanding of any topic. Even the assessments should not only test textbook knowledge but also test how well the student can apply it to real-life scenarios, enabling them to relate to the subject in an interactive space.
- Though the above scheme has promising advantages, designing such questions is very time - consuming and demanding for the instructor.
- This gives rise to the need of an automated customized assessment generation software that can create relevant, enjoyable and brain-teasing assessments for the students with minimum effort.

APPROACH TOWARDS THE PROBLEM

- With the increasing need for individualistic attention to student learning, we make the use of advancements in technology to assist teachers in these tasks.

- We leverage Large Language Models (LLMs) alongside the MERN Stack to aid teachers in creating customized assessments tailored to judge comprehension levels of individual students.

REQUIREMENTS

1.Input Form

- This page will feature input fields for Topic, Number of Questions, Contextual Keywords and drop-down menu for selecting the Question Type (only one type of questions generated at a time, amongst MCQs, Short Answer Questions and Long Answer Questions)
- It should support file uploads for context materials, accommodating multiple files (in PDF form).
- The user must be allowed to generate a maximum of 20 questions at once.
- The input field for topic should have a character limit of 125 characters.

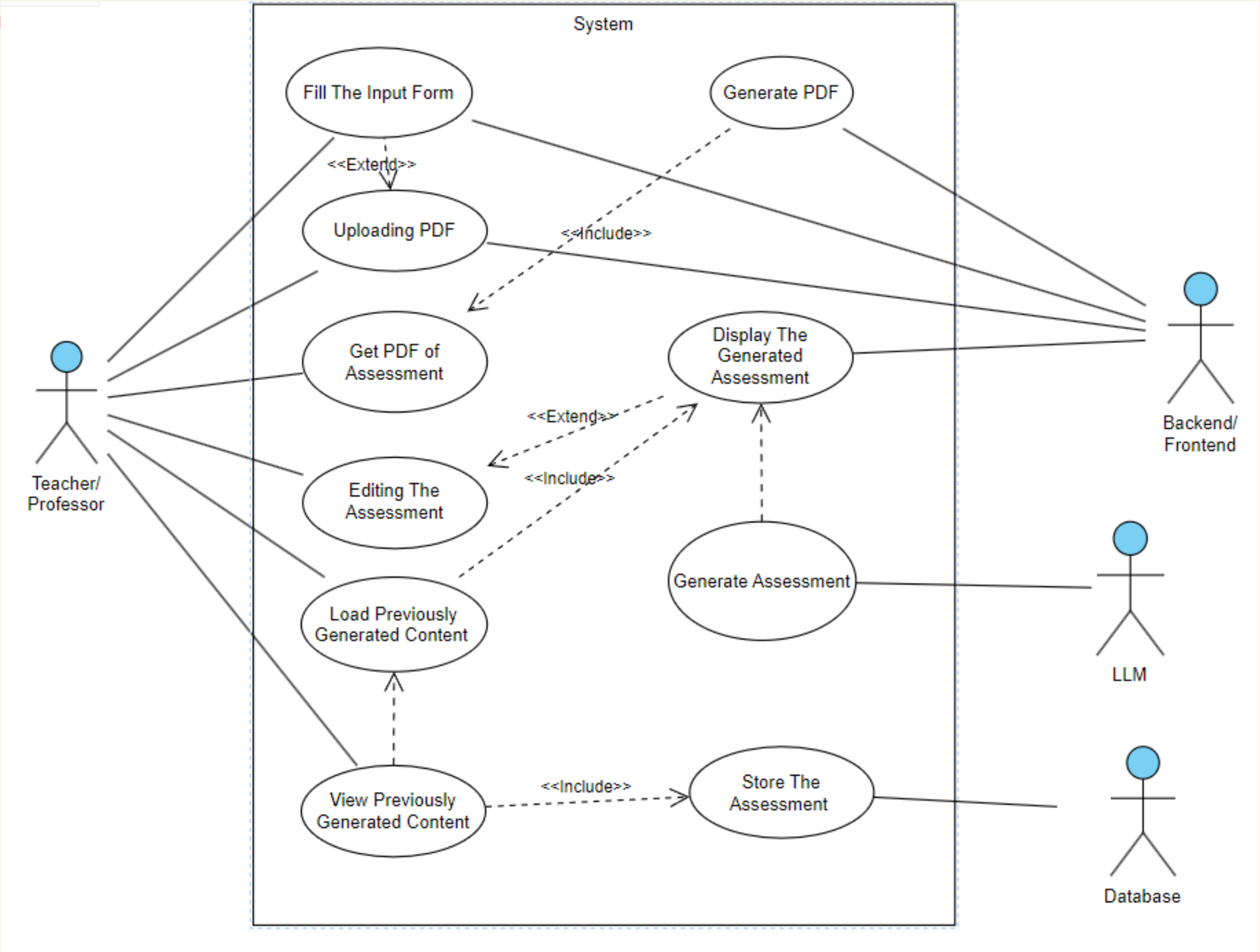
2. Assessment Page

- At the top of the page, a summary of the user input must be displayed.
- The questions generated according to the user input must be displayed on this page.
- There should be an option to enter the name of assessment and save it, to store it for future reference.
- Each of the Question and the corresponding answers (options in case of MCQs) will be editable.
- At the end of the assessment an option to export the assessment as PDF should be present.

3. Existing Assessments Page

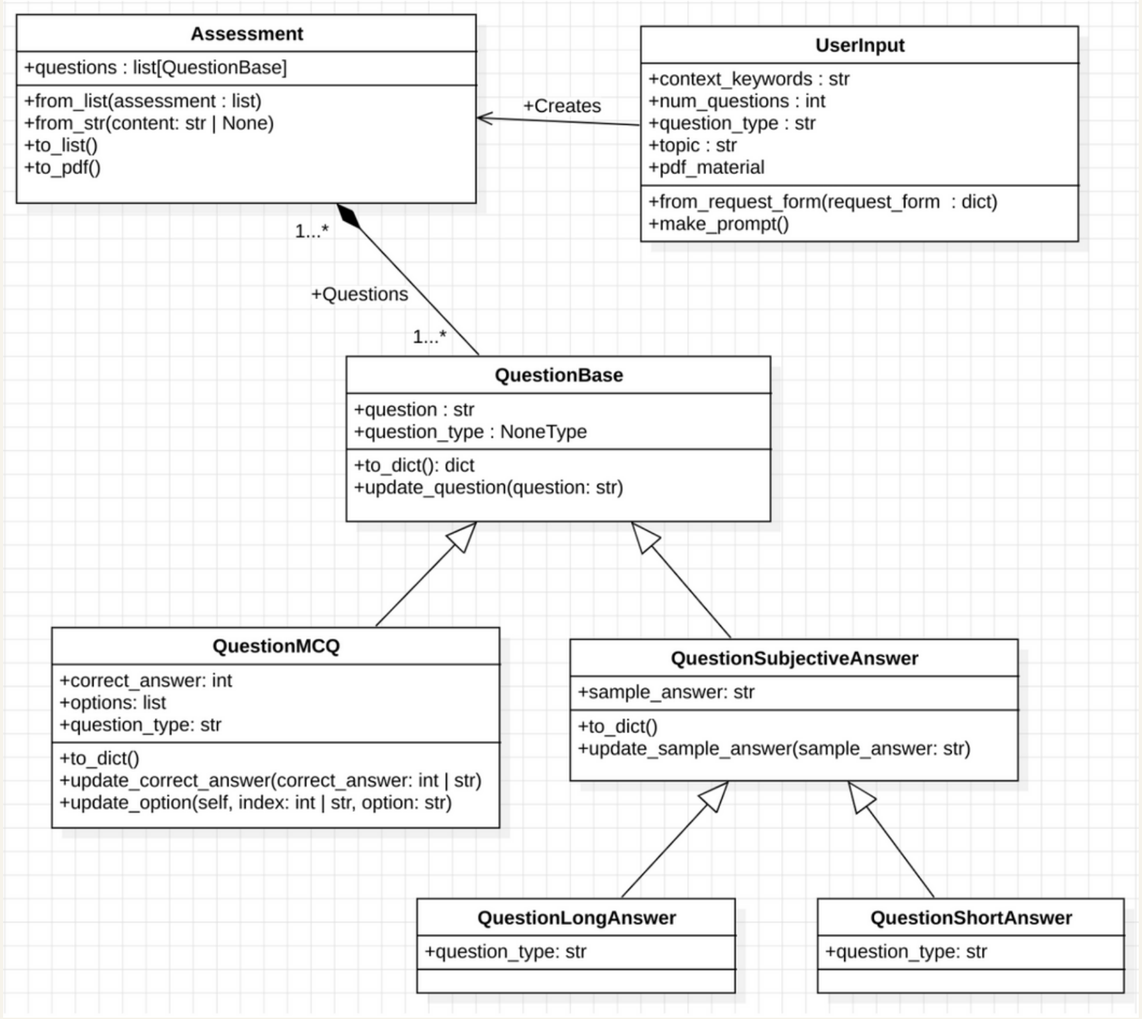
- On this page, all the assessments generated on the web application are displayed with their respective date and time of generation.
- The user can click on the name of any of these and view the assessment (in its latest version), make changes to it, save it and export it as PDF.

USE CASE DIAGRAM



DESIGN

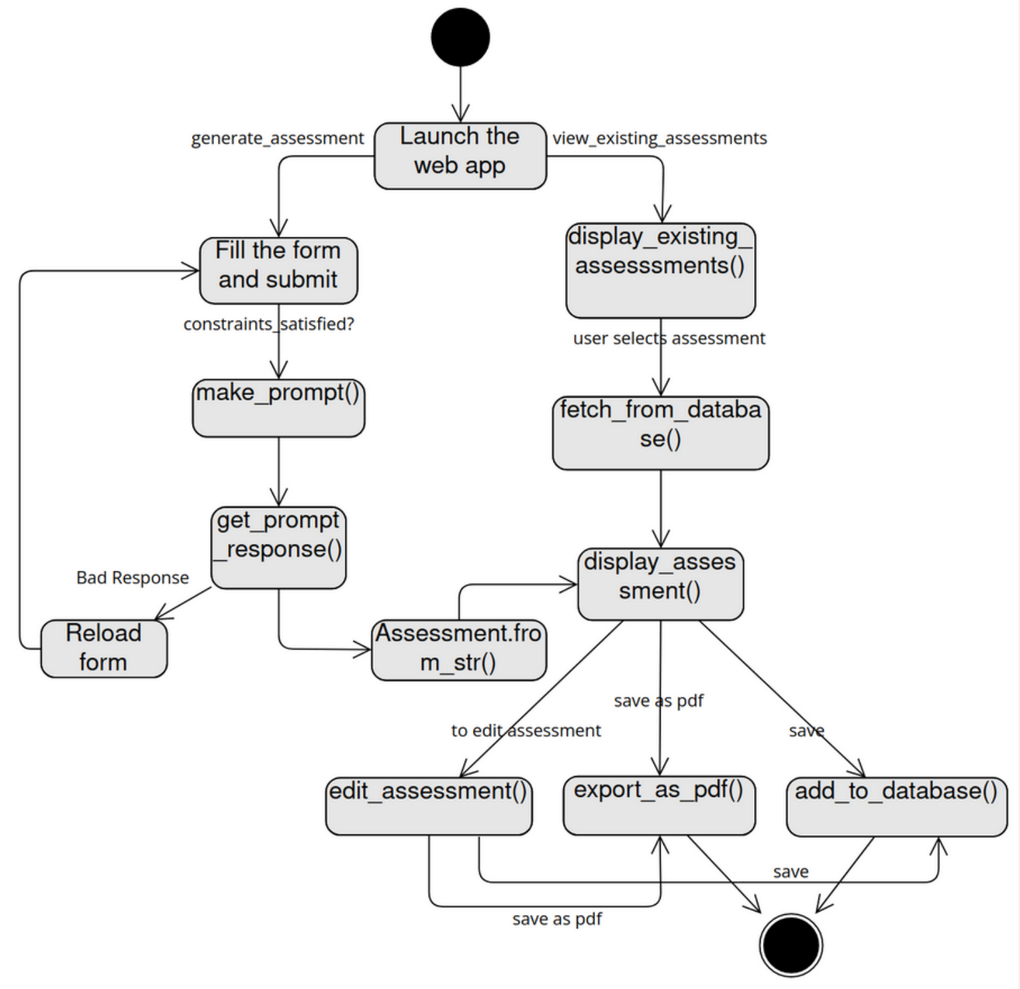
Class Diagram



Modelling Tool: StarUML

DESIGN

State Diagram



Modelling Tool: VisualParadigm

IMPLEMENTATION

Front End Design

- React (antd)
- JavaScript

Testing Methods

- PyTest
- Manual User Testing

Back End

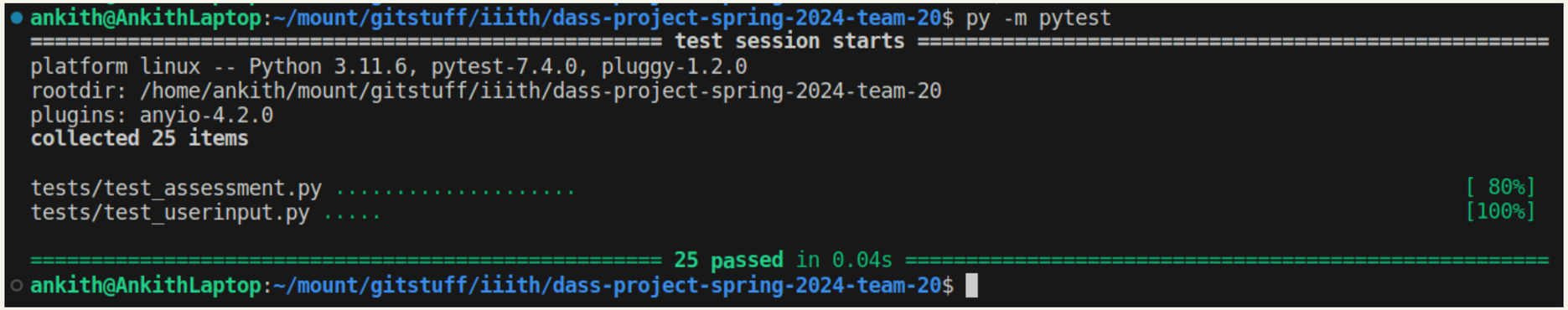
- Python
- Flask
- MongoDB

Large Language Model

- LlaMA
- HuggingFace

TESTING

- Started with unit testing of all modules and components in back end and front end respectively using PyTest followed by integration testing.
- For the front end, on recommendation of the client, the tests are manual and user tests.
- For the back end, testing is complete for the implemented modules using PyTest. Particularly, userinput and assessment modules were tested.



Milestone Schedule

Milestone	Due Date	Release	Deliverable?
Create draft requirements	07/02/24	R1	No
Finalize requirements	14/02/24	R1	Yes
Implement initial backend API	15/02/24	R1	Yes
Making API calls to LLMs	17/02/24	R1	Yes
Basic UI design of the user input form (page 1), integration with backend	18/02/24	R1	Yes
Handle and parse LLM output	21/02/24	R1	Yes
Implement UI of generated questions output (page 2)	25/02/24	R1	Yes
Implement editability of page 2	06/03/24	R2	Yes
Allowing the users to upload reading materials, in the form of PDFs.	13/03/24	R2	Yes
Handle PDF by passing context to LLM	15/03/34	R2	Yes

Feature requirements (described using use cases)

No.	Use Case Name	Description	Release
1.	Filling the Input Form (on page 1)	The user fills in an input form providing details for the topic (textbox), question type (dropdown), number of questions (textbox), context for the assessment (file upload) and the values to be inculcated (textbox)	R1
2.	Uploading multiple Reading Materials (Page 1)	The user can upload multiple files as context documents (or reading material) for the assessment generation.	R1
3.	Viewing Generated Assessment (Page 2)	The user, after filling in the input form, views the assessment generated in a readable format.	R1
4.	Editing the Assessment Generated (Page 2)	The user gets the option to edit the individual questions in the generated assessment.	R2
5.	Exporting the assessment as pdf. (Page 2)	The user can export the generated assessment as pdf.	R2
6.	Viewing a List of previously generated assessments (Page 3)	All the previously generated assessments on the application can be viewed by the user.	R2
7.	Load a previously generated assessment and export it as pdf. (Page 2)	The user can revisit any previously generated assessment and export them as pdf.	R2

Test Planner and Tracker

20 Archisha Panda, Ankith Pai, Prakh

Test No. ID	Related Use case	Pre-conditions	Test Description (steps)	Expected Outcome	R1 Outcome (color code cell background)
1	Filling the input form	1. User is on the generate assessment page 2. The input form is displayed correctly	User enters values for all the fields that is Topic, Type of Assessment, Number of Questions and Contextual Keywords correctly according to conditions. After filling the form, user clicks on the submit button.	User is redirected to the View Assessment Page which displays the generated assessment along with the prompt that was used to query the LLM. The prompt has placeholders for fields filled through the form. These placeholders are correctly replaced with the	
2	Filling the input form	1. User is on the generate assessment page 2. The input form is displayed correctly	User enters a topic that exceeds the character limit (125). Rest of the fields are correctly filled and Submit is pressed.	Display an error message saying character limit exceeded immediately while user is filling the form. If rectified, error message goes away and form is submitted on clicking Submit redirecting to View Assessment page as described in Test Case 1. If not rectified, form is reloaded with other fields	

PLANNED...

DELIVERED?

PROJECT PROGRESS

1

Implemented form design for teacher to enter into input fields and initiate request for new assessment by clicking on Submit button.

2

The input is fed into a pre-defined prompt architecture which prepares the prompt and sends it to the LLM through an API call.

3

The response from the LLM is parsed and received as a JSON string which is then converted to a list of assessment questions and displayed on the screen.

4

Added option to upload pdf files in the input form on Page 1.

5

Implemented ‘export to pdf’ option which saves the assessment as a PDF file locally in the user’s system.

6

Release 1

PROJECT PROGRESS

New Assessment

Enter the main topic or subject of the Assessment to be Generated. (NOTE : The character limit is 125)

* Topic : Projectile Motion

Choose the type of questions required in the Assessment from the options provided.

* Type of Assessment : MCQs

Enter the number of questions in the Assessment (NOTE : The maximum limit is 20)

* Number of Questions : 5

In this field you can enter the contexual keywords i.e., specific concepts which are to be integrated with the main topic for Assessment Generation

Contextual Keywords : For a child who loves cricket

You can upload file(s) for providing the content for Assessment Generation

Upload PDF : Upload

Submit

The below assessment has 5 mcqs question(s) on the topic 'Projectile Motion'.
Context keywords: For a child who loves cricket.
No context PDF files were uploaded.

Assessment Questions

Q1: If a cricket ball is hit at an angle of 45 degrees, what type of motion does it follow?

- Circular motion
- Parabolic motion
- Straight line motion
- Random motion

Q2: What is the effect of air resistance on the projectile motion of a spinning cricket ball?

- It increases the range
- It decreases the range
- It does not affect the range
- It changes the trajectory

Q3: Which of the following factors affects the range of a cricket ball in projectile motion?

- Initial velocity
- Angle of projection
- Air resistance
- All of the above

Q4: At what angle should a cricket ball be hit to achieve the maximum range?

- 30 degrees
- 45 degrees
- 60 degrees
- 90 degrees

Q5: What happens to the horizontal velocity of a cricket ball in projectile motion?

- It increases with time
- It decreases with time
- It remains constant
- It becomes zero at the highest point

Export to PDF

DEMONSTRATION

https://iiitaphyd-my.sharepoint.com/:v:/g/personal/ankith_pai_research_iiit_ac_in/EcZzZHsYHV9OlmQUa49M1ckBW0i8noYUS3aTX3Y9YV4JbQ?e=EbW4xf&nav=eyJyZWZlcnJhbEluZm8iOnsicmVmZXJyYWxBcHAiOiJTdHJlYW1XZWJBcHAiLCJyZWZlcnJhbFZpZXciOiJTaGFyZURpYWxvZy1MaW5rIiwicmVmZXJyYWxBcHBQbGF0Zm9ybSI6IldlYiIsInJlZmVycmFsTW9kZSI6InZpZXcifX0%3D

PLAN FOR RELEASE 2

1. Provide editing option to user to edit any question, (options in case of MCQs) and sample answer provided by the LLM.
2. Use a PDF rendering software to extract content from PDF for it to be used for assessment generation.
3. Maintain a database storing all the generated assessments. This list should be displayed on Show Existing Assessments Page.
4. Implement viewing of any previously generated assessment as per user’s choice. User can edit this assignment to store a new version of the same.
5. Replacing the LLM model. For the final version of the web application, LlaMA would be used instead of Hugging Face.

CHALLENGES FACED

Issues With LLM Model

- Original plan was to use LLaMA as the LLM for our system but due to deployment server issues from client's side, our software uses HuggingFace as the LLM for the time being.
- HuggingFace has a token limit restricting our prompt size due to which we cannot support a very lengthy context.
- For Long Answer Questions, the LLM is unable to generate more than 15 questions.
- Certain inconsistencies have been observed like number of questions required were 15 but only 13 were generated.

Readability of PDF Generated

- When generating a PDF with jsPDF and handling content that spans multiple pages, setting margins or controlling how content breaks across pages can be challenging.
- The jsPDF library itself does not directly offer a feature to automatically adjust margins for each page or to neatly manage page breaks for HTML content converted to PDF.
- Using html2canvas on the other hand leads to loss of search functionality as the text is converted to an image.

INDIVIDUAL CONTIBUTIONS

Ankith Pai

- Worked on the design and implementation of various backend classes like Assessment, Question* and UserInput
- Worked on integration of the LLM into the backend
- Wrote some backend unit tests
- Worked on the documentation of various MoMs, Project Synopsis, Project Plan, SRS Document, Design Document, and also a README documentation at project root

Archisha Panda

- Worked on the front end design for the web application.
- Parsing the output generated by the LLM and displaying it on the Assessment Display Page, Navigation Bar.
- Implementing the Export to PDF option on the Assessment Display Page.
- Worked on the documentation of various MoMs, Project Synopsis, Design Document, Test Planner.

Gargi Shroff

- Worked on the front end design for the web application.
- Designing the Input Form and adding various constrains on the input fields, Navigation Bar.
- Displaying the summary of user input on the Assessment Display Page.
- Worked on the documentation of various MoMs, Project Synopsis, SRS Document, Design Document.

Prakhar Jain

- Worked on JSON handling of LLM output in backend
- Worked on PDF upload handling
- Wrote some backend unit tests
- Worked on the documentation of various MoMs, Project Synopsis, Project Plan and SRS documents.

THANK YOU