Team Proposal Report

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Introduction

The "Venn Diagram Visualisation" project offers a comprehensive and innovative learning solution for students studying Mathematics or Computer Science on the crucial subject of Set Theory. This program aims to provide an interactive and engaging learning experience that will enable students to practise and reinforce their understanding of set theory through dynamic visual aids.

The program will have two main sections: a Teacher section and a Student section. The Teacher section allows instructors to upload their questions for students to solve, providing a customised and tailored learning experience for the students. The student section, on the other hand, has a randomly generated quiz that tests the user's comprehension of set theory in a variety of ways, a cheat sheet of all the relevant concepts and a teacher's assignment section where the user can see and answer all the questions uploaded by the teacher. The quiz includes three main evaluation components: matching set notations with their corresponding sections within a Venn Diagram and matching set notations with the correct set option. For example, if A = {1,2,3}, B = {2,3,4}, the student should select the correct set of A U B, and match Venn Diagrams with the correct set notation option. In the quiz, there is an option to create a group with their friends, where they can compete with each other in solving questions. Once all the group members have completed their quiz, we will display the leaderboard of the top scorers from the group.

The program generates questions of various difficulties and includes a sophisticated scoring system that will email the questions the user failed to answer, allowing the user to learn from their mistakes and track their progress. The cheat sheet section assists users in refreshing their knowledge of key concepts. The inbuilt Google Translate feature allows users to translate the content into different languages. The target audience for this project is high school students and first-year university students aged 17 to 20.

List of components

Python Dictionary: Whenever the question's answer is captured from the text box, the result will be stored in a dictionary as it is easy to store two outcomes(right/wrong) with their corresponding questions as (key, value) pairs in Python.

Another such dictionary will be used to store the question and its answer to the quiz.

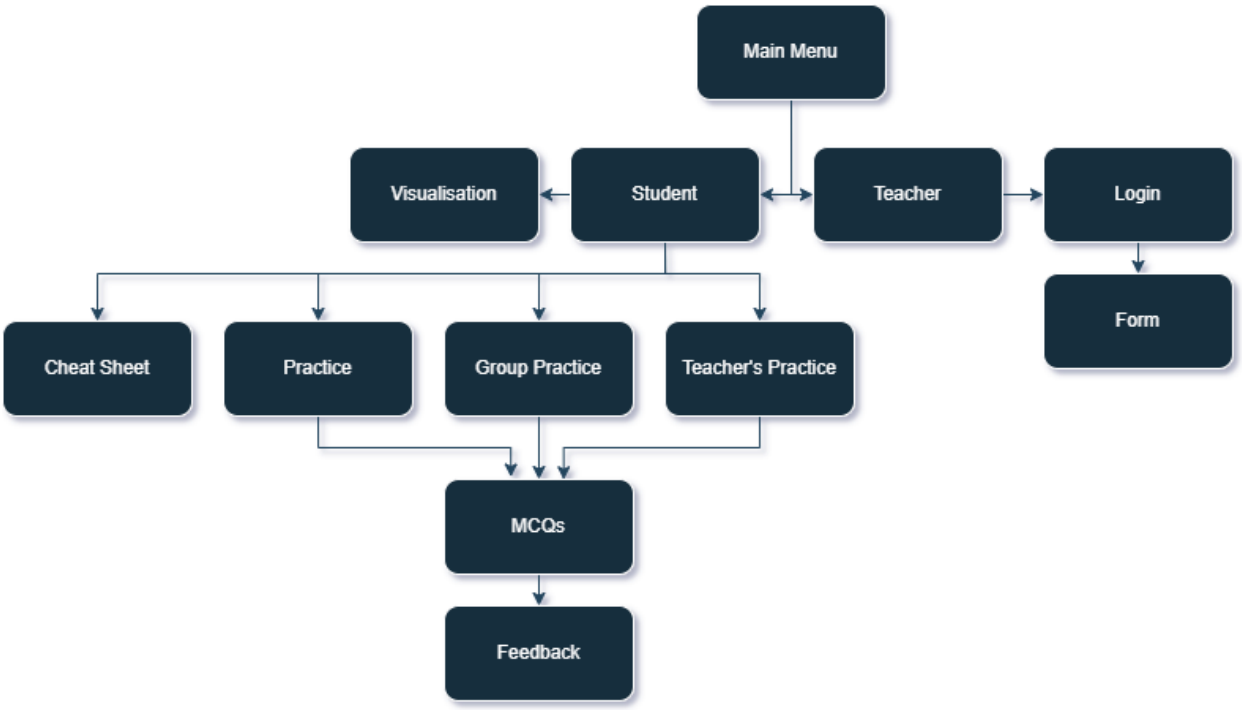
Python Strings: A string format will be specified for the teachers to input their assigned questions which will be later converted to its appropriate data structure by our algorithm and stored accordingly.

Python Strings will also be used to check the login details of the teacher upon sign-in as string comparison in Python is extremely easy.

Python Sets: Python's implementation of a set makes it extremely easy to perform basic operations such as union, intersection, difference, and complement which will be used to validate answers for the randomly generated questions.

MySQL: It is an open-source relational database management system. We have used MySQL because of its ability to provide comprehensive support for every application development need and has proper support for Python applications.

Algorithms : We will be using Insertion sort to sort all the scores after the quiz for the Leaderboard.



Example of exercises

In the program, there will be four types of questions:

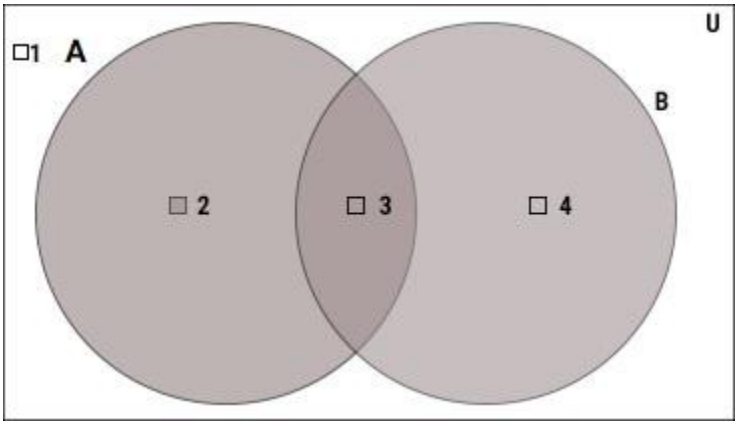
1. The program will generate a set notation, and the user will need to select the correct section of the Venn diagram
2. The program will generate a set notation, and the user will need to select the correct set notation option in an MCQ
3. The program will generate a Venn diagram, and the user will need to select the correct set notation option in an MCQ
4. The program will ask each member of the group to make 10 questions and then it will randomly assign the questions to each member. The members then have to solve all the questions within the time limit. After the quiz is over, it will then display the leaderboard of the top scorers in the group.

The first three different styles of questions will test the users' overall understanding of Venn diagrams and set notations, allowing them to consolidate their understanding based on what type of questions they got wrong. The fourth type will encourage the users to learn Set Theory in a fun and interactive way with their friends.

1. Set notation → Venn diagram:

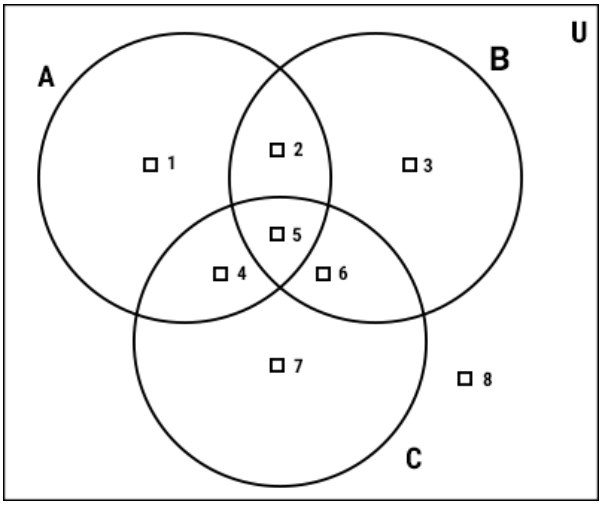
For this type of question, the user will be required to shade in the Venn diagram when given a set notation. The Venn diagram could contain two sets or three sets depending on the difficulty of the question

Example 1. Shade A ∩ B



Answer: 3.

Example 2. Shade A U B



Answer: 1,2,3,4,5,6,7

2. Set notation → Set notation

For this type of question, the user will be required to select a choice from an MCQ when given a set notation. The set notation that is given will also depend on the difficulty selected. For instance, a hard difficulty could contain three sets with different various operators being used such as complement operators.

Example 1.

Given U = {1,2,3,4,5,6,7,8,9,10}, A = {1,3,5,7,9}, B = {1,4,6,7,8,10}. What is A/B?

- {1,3,5,8}
- {3,5,9}
- {1,3,7}
- {4,6,10}

Answer: {3,5,9}

Example 2.

Given U = {1,2,3,4,5,6,7,8,9,10}, A = {1,3,5,7,9}, B = {1,4,6,7,8,10}, C = {3,5,8,11} What is (A/B) ∩ C?

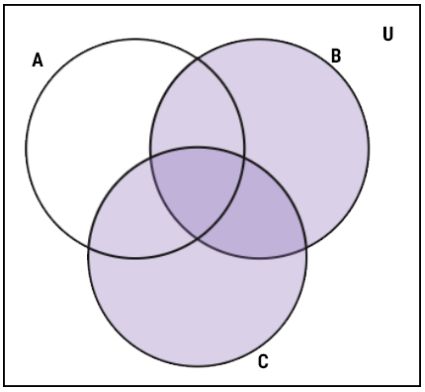
- {4,1,5,2,6}
- {3,1,5,6}
- {1,5,11}
- {3,5}

Answer: {3,5}

3. Venn diagram → Set notation

For this type of question, the user will be required to select a choice from an MCQ when given a shaded Venn diagram.

Example 1. Find the set notation of this Venn diagram



- (A ∩ B' ∩ C')'
- (A U B) ∩ C
- (A U B) ∩ C'
- B ∩ C

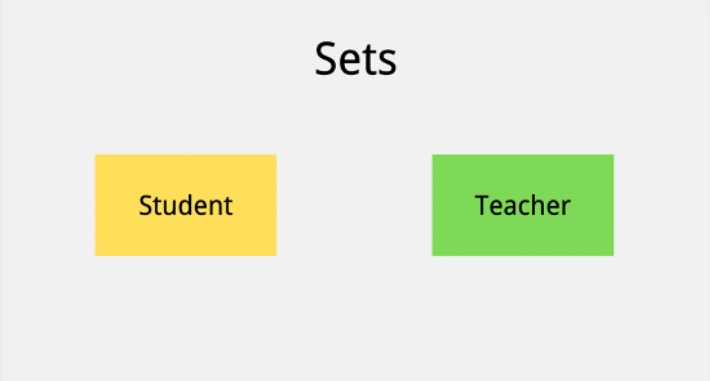
Answer: (A ∩ B' ∩ C')'

User Interface

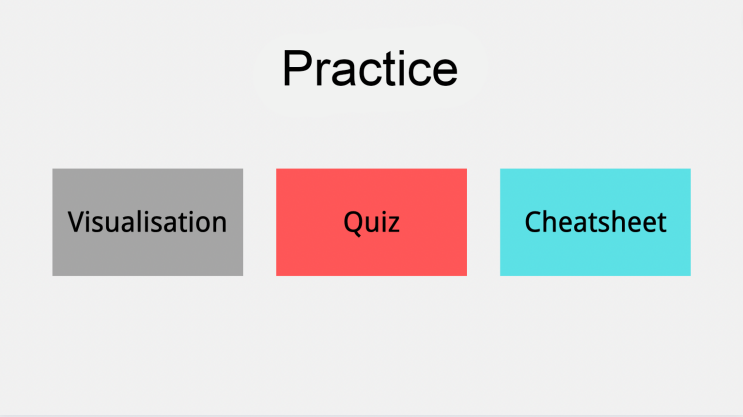
The user will use a Graphical User Interface (GUI) to interact with our program. The main user interface will be produced using the Tkinter module in Python.

Some Important components of our interface are as follows:

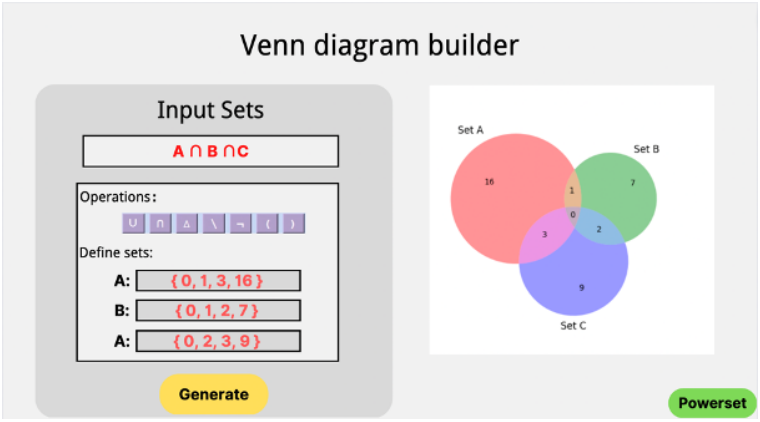
Welcome Screen: Teachers and students have different functions in our project. So, we have separated their login screens to avoid confusion.



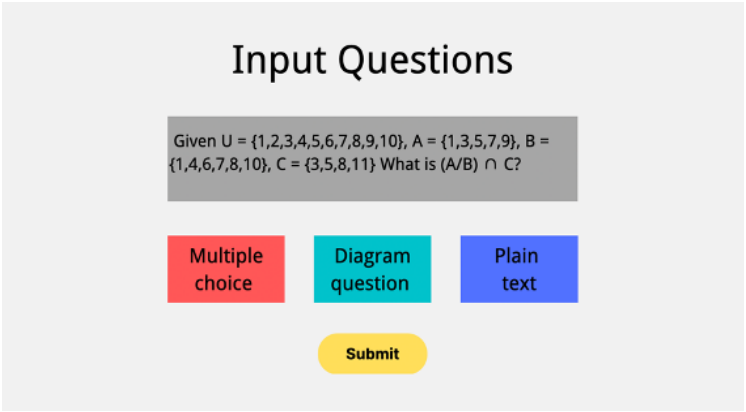
Practice Section: This section has three options, the **visualisation option** shows the corresponding Venn diagram with the sets the user has entered, the **quiz option** allows the user to answer questions that have been set in advance by the teacher (question types demonstrated in the previous page) and the **cheat sheet option** shows the user some standard set operations.



Venn Diagram Builder: In this section, the input module is represented by the grey area on the left. The user can define set relations in the first column using the operations listed below and before we feed this input to the Venn diagram builder, we run it through a series of tests to verify that the set relation entered by the user is correct and if an invalid character is found, an appropriate error message is shown. Additionally, the user can customise the numbers in each set. The Venn diagram is displayed in the white area on the right, and a green button located in the bottom right corner provides direct access to calculating a set's powerset.



Teacher's Interface: In this interface, the teacher is provided with a grey input box where they can enter a question. They have the option of selecting from three distinct question types: multiple choice questions (MCQs), Venn diagram questions , and questions in plain text format. After the teacher has completed adding the questions, they are subjected to a comprehensive series of verifications to ensure the validity of the set relations entered. If any invalid characters are detected, an error message specifying the issue will be displayed. The questions entered by the teacher will be available to the students in the teacher's assignment section.



Quiz Section : In this section, the user can take the quiz independently or form a group by inviting their friends. If the user opts for the group option, once all members have joined, each member will be responsible for creating 5 to 10 questions. The questions will then be shuffled and assigned to different group members.The quiz will commence once all questions have been assigned. Upon completion of the quiz, a leaderboard will be displayed highlighting the top scores among group members. After every quiz whether done independently or in a group, the user has the option to request feedback and access to the answer key for the current quiz.

Framework/Language

This learning tool will be implemented using Python. We have chosen Python as it provides extensive libraries for a graphical user interface and after conducting extensive research on various libraries for graphical user interfaces, we selected Tkinter for our project due to its robust features and versatility. Along with Tkinter, we would be using Matplotlib for generating Venn diagrams.

Tkinter: Its implementation in Python is characterised by its clarity and simplicity, allowing users to write the graphical user interface and program the settings or functionality within the same script.

We will also use **MySQL** to store information in databases. The information stored in the database will consist of teacher logins, questions used for the group activity and teacher questions that will be used for the student assessments. We will also store the individual scores for the teacher assessment, which allows teachers to check the knowledge of each individual student and what they need to improve.