

Final Year Project Report

GREPBING

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by

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In Partial Fulfillment

Of the Requirements for the degree

Bachelors of Engineering in Software Engineering (BESE)

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DECLARATION

We hereby declare that this project report entitled “GREPBING” submitted to the School of Electrical Engineering and Computer Science (SEECs), is a record of the original work done by us under the guidance of Supervisor “Dr. Sidra Sultana” and that no part has been plagiarized without citations. Also, this project work is submitted in the partial fulfilment of the requirements for the degree of Bachelor of Engineering in Software Engineering.

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Date:

Place:

DEDICATION

This project has been a challenging journey filled with obstacles and struggles. We would like to dedicate this project to our team and mentors who have been our constant support system. Their unwavering belief in our abilities and their unconditional love and support has been the driving force behind our success. We are forever grateful for their faith in us and the encouragement they have provided us throughout our journey.

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ABSTRACT

Nowadays students are more inclined towards the application end without having basic conceptual clarity. Students are sometimes afraid or reluctant to know the concept behind crucial terminologies of their domain. Some terms require a great emphasis and without knowing some of the basic terminologies, students cannot have a sound grip of the course outcomes.

Proper linkage between concepts is not well defined in current sources of web and students must explore multiple sources to acquire a single concept, which can lead to loss of interest if a student must navigate different sources for examples and diagrams etc.

The idea of this project is to compose a knowledge repository of all STEM concepts. We are focused to bridge the gap between university and industry by providing conceptual clarity to students in STEM related courses. Knowledge repository is composed with appropriate assessments with the help of Subject Matter Experts and Knowledge Group Heads.

Keywords: Knowledge Repository, Subject Matter Experts, Knowledge Group Heads, STEM Concepts.

INTRODUCTION

1.1 Purpose

GrepBing is an educational resource that seeks to provide comprehensive and accessible information in STEM disciplines. The repository of knowledge is built through collaboration with subject matter experts (SMEs) and knowledgeable individuals in the field. GrepBing's objective is to bridge the knowledge gap resulting from the lack of a unified platform where students can access all STEM courses.

This document will provide a clear and comprehensive overview of GrepBing's technical and functional requirements, system architecture, and design. It will serve as a guide for developers and stakeholders, offering insights into the website's objectives, functionalities, and technical prerequisites, as well as its intended behavior and performance expectations.

1.2 System Overview

This initiative aims to establish a comprehensive knowledge hub that addresses the limitations of existing e-learning platforms, catering to learners at all stages of their educational journey. A distinctive feature of this project is its inclusive approach, allowing individuals to contribute to the platform's catalog of concepts, subject to predefined criteria. To ensure quality control, a hierarchical system of roles is implemented to review, evaluate, and maintain the concepts and contributors, ensuring that all added content, including concepts, quizzes, and diagrams, meet the required standards and fulfill their intended purpose. Learners are not only able to acquire knowledge on specific topics but also engage in active learning by practicing their understanding through meticulously vetted questions, ensuring originality and

authenticity. Detailed information about the roles involved is provided in subsequent sections.

LITERATURE REVIEW

E-learning platforms have been gaining popularity among students, professionals, and individuals who are looking to expand their knowledge base, acquire new skills or advance their careers. These platforms offer a wide variety of courses and learning opportunities that cater to diverse interests and skill levels. In this literature review, we will focus on five popular e-learning platforms, including Coursera, Udacity, LinkedIn Learning, DataCamp, and Codecademy. We will examine the pros and cons of each platform.

2.1 Coursera

Coursera is a well-known internet learning stage that accomplices with driving colleges and foundations to offer seminars on a great many points, from software engineering to business and medical care. One of the greatest benefits of Coursera is that you can join pretty much every class free of charge, for however long you are not meaning to procure a culmination testament. The courses presented by Coursera are of great, and students can profit from the ability of teachers and experts from lofty foundations like Stanford, Duke, and Yale. In any case, Coursera isn't novice well disposed, and a portion of its courses might expect students to have past information regarding a matter. This implies that students might leap to cutting edge ideas without having taken in the essential primary ideas.

2.2 Udacity

Udacity is another well-known e-learning stage that spotlights on courses connected with software engineering and business. The stage accomplices with driving experts and organizations like Nvidia, Google, and Mercedes to make great courses that give functional specialized information. One of the one-of-a-kind elements of Udacity is that it offers profession counsel to paying understudies,

assisting them with composing their CVs and plan the abilities they need to get. Udacity's finishing confirmations are viewed in a serious way by managers, and a few organizations like Lyft, Mercedes, Nvidia, and Google investigate Udacity graduated class to satisfy employment opportunities. Notwithstanding, the limit of Udacity is that it needs assortment, and its courses are costly.

2.3 LinkedIn Learning

LinkedIn Learning is an e-learning stage that coordinates with LinkedIn, making it alluring to clients needing to push ahead with their vocations. The stage offers over 18,100+ seminars on various subjects, from calculation sheet tips to astrophotography. LinkedIn Learning is all around created, and the general nature of its courses is higher than a large portion of its rivals. In any case, not at all like different stages, LinkedIn Learning doesn't offer free courses, just a 1-month free preliminary.

2.4 DataCamp

DataCamp is an e-learning stage that spotlights on intelligent learning with drawing in activities and recordings. The stage takes care of both outright fledglings and students with some information, and its courses are intended to give a far-reaching comprehension of information science and examination. DataCamp offers a Beginning With the expectation of complimentary arrangement that gives students admittance to starting sections of courses and evaluations. The valuing plan of DataCamp is clear and straightforward, which is reviving, as not all web-based stages are so straightforward. Be that as it may, a portion of DataCamp's video instructional exercises is a little short and ailing exhaustively, which might leave students feeling like they are missing something.

2.5 Codecademy

Codecademy is an e-learning platform that spotlights on intelligent coding courses, which are not difficult to process for complete beginners. The stage covers a wide assortment of programming dialects, including HTML, CSS, JavaScript, and some more. Codecademy has a fundamental free arrangement that permits students to appreciate intuitive examples and day to day rehearses. In the wake of acquiring reasonable experience, students can make their own portfolio-commendable undertakings to show expected spotters. Notwithstanding, one of the impediments of Codecademy is that there is restricted data accessible about the teacher who made the course.

2.6 MasterClass

MasterClass is an e-learning platform that offers courses taught by world-renowned experts in their respective fields. Some of the most popular courses include those taught by writers such as Margaret Atwood and Malcolm Gladwell, chefs like Gordon Ramsay and Thomas Keller, and athletes like Serena Williams and Steph Curry. MasterClass courses are unique in their cinematic quality and are designed to provide an immersive and engaging experience.

One of the major advantages of MasterClass is its affordability. Compared to other educational platforms, MasterClass is relatively cheap, with an annual subscription costing \$180 for unlimited access to all courses. This pricing strategy makes the courses accessible to a wider audience, making it an attractive option for people who want to learn from experts but cannot afford the high costs associated with traditional education.

Notwithstanding, one of the disadvantages of MasterClass is the restricted scope of points accessible. While the courses cover a scope of fields like games, filmmaking, food, composing, business, science, and governmental issues, the determination is yet restricted contrasted with other e-learning stages. Furthermore, MasterClass offers no free courses, so understudies can't see any courses prior to buying into them.

In conclusion, e-learning platforms have become an increasingly popular option for people looking to learn new skills or further their education. Each platform has its own benefits and drawbacks, and the choice of platform ultimately depends on the learner's needs and preferences. Coursera, Udacity, LinkedIn Learning, DataCamp, and MasterClass are just a few examples of the many e-learning platforms available today. Regardless of the platform, e-learning has the potential to revolutionize education by providing affordable and accessible learning opportunities to people around the world.

PROBLEM DEFINITION

The current e-learning systems face several limitations that hinder the user experience and the effectiveness of the learning process. Some of them are discussed below:

3.1 Cold Start Problem

One of the primary difficulties is the cold start issue, where new clients are not given customized proposals and need to explore the stage all alone. This can prompt disarray and an absence of commitment, bringing about lower learning results.

3.2 Personalized Learning Paths

Users should be provided with a personalized learning path that is tailored to their individual learning needs and preferences. This will ensure that the content presented to the user is relevant and engaging, leading to improved learning outcomes.

3.3 Adaptive Assessments

Assessments should be adaptive and personalized, adjusting to the user's level of knowledge. This will improve the accuracy and efficiency of the assessment system.

3.4 Gamification

Gamification elements should be included in the platform, such as badges, points, and leaderboards. This will improve user engagement and motivation, making the learning experience more enjoyable and rewarding.

3.5 Collaborative Learning

The platform should include features that facilitate collaborative learning, such as discussion forums. This will improve user engagement and motivation, as well as provide users with the opportunity to learn from their peers.

3.6 Personalized Recommendations

The platform should include a personalized recommendation system that recommends content to users based on their preferences and learning history. This will ensure that the content presented to the user is relevant and engaging, leading to improved learning outcomes. For new users, a basic set of recommendations can be provided based on commonly selected topics or general interest areas.

By incorporating these features into the e-learning platform, we can overcome the limitations of previous e-learning systems and provide users with a personalized and engaging learning experience that leads to improved learning outcomes.

METHODOLOGY

In this section we will discuss the methods, approaches, techniques, and tools we used for our solution.

4.1 Approval Chain

At Intelligent Grepbing, we believe that high-quality content is essential for an effective e-learning platform. That's why we have developed a rigorous process to ensure that every concept on our platform meets our high standards.

The first step in this process is the creation of a Template Concept by our Knowledge Group Head (KGH). This template serves as a guideline for contributors. Contributors are required to add essential information, such as a concept definition, description, examples, and a quiz with a minimum of 50 questions. This information is critical for ensuring that the concept is comprehensive and that learners have a complete understanding of the topic.

Once the contributor submits their concept, it undergoes a review process by our KGH. During this review, the KGH has the option to accept, reject, or ask for revisions to the proposed concept. We believe that this review process is essential for ensuring that our platform is filled with high-quality content that has been vetted by experts in the field.

When a concept is approved by the KGH, it goes live on our platform and becomes visible to learners. This ensures that only high-quality, vetted content is available to learners, and that the content is consistent in terms of format and structure. We are committed to providing our learners with the best possible content, and we believe that our approval chain process is a critical component of achieving this goal.

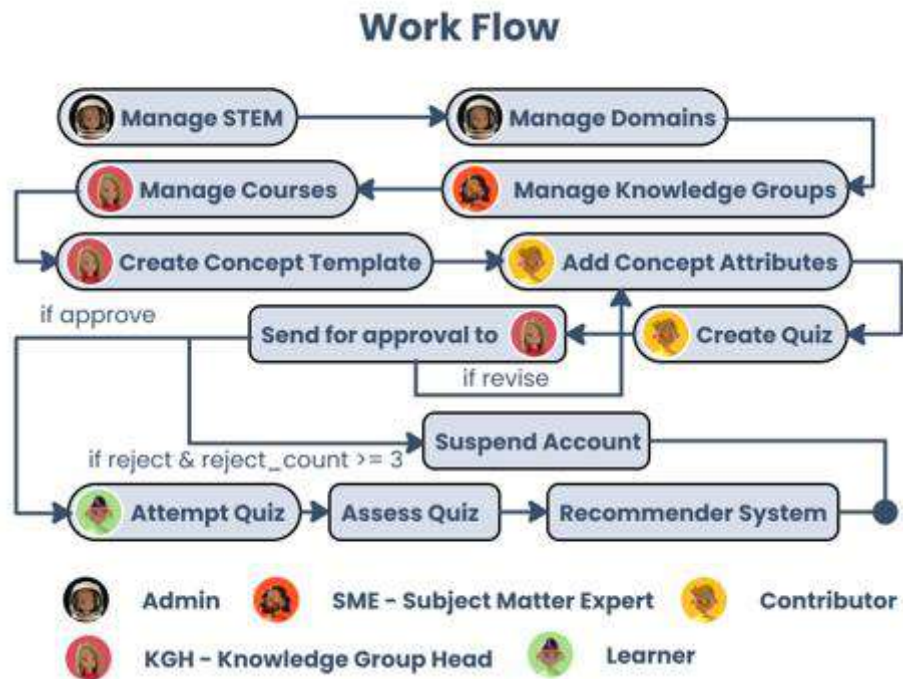


Figure 1: Workflow Diagram

4.2 Collaborative Learning

At our system, we utilize collaborative learning to provide collaborative recommendations to our users. Specifically, we have implemented a collaborative recommender system using the KNN with means algorithm. This approach enables us to recommend user-item concepts based on the preferences and behavior of similar users.

1. We set up a Reader object to parse the ratings on a scale from 1 to 5.
2. We retrieve a list of concepts that have an approved status.
3. We create a dataset consisting of all user ratings for the concepts on the list.
4. We load the dataset into a Surprise Dataset object.
5. We define the similarity options to be used in our model. We choose the cosine similarity and set the user_based option to True.
6. We build a KNN model using the KNNWithMeans algorithm.
7. We build a training set from the dataset and then build an anti-testset by removing all the ratings from the training set.
8. We fit the KNN model on the training set and generate predictions for the anti-testset.
9. For each prediction, we create a CollaborativeRecommender object containing the learner (user), the concept, and the estimated rating.
10. We return a list of all the CollaborativeRecommender objects.

To start, we first retrieve a list of active concepts from our database and create a dataset that includes the user ratings for each concept. We use the Pandas library to process and transform the data into a format that can be loaded into the Surprise library, a Python scikit that provides a range of collaborative filtering algorithms.

We then define the similarity options for the KNN model. In this case, we choose the cosine similarity metric and set 'user_based' to True, which means that we will be using user-item collaborative filtering. Next, we train the model on the dataset using the full training set, and generate predictions for the anti-test set, which consists of user-concept pairs that have not been rated.

After obtaining the predictions, we store the results in a list of CollaborativeRecommender instances, which represent the recommended concepts and their estimated ratings. Each instance includes information about the learner (i.e., the user), the recommended concept, and the estimated rating.

To achieve this recommendation system, we also use Django Celery to run the recommendation task asynchronously, which allows us to handle multiple requests simultaneously and speed up the recommendation process. We also utilize Django signals to automate the recommendation process whenever a new user rating is added to the database.

In summary, our cooperative recommender framework utilizing the KNN with implies calculation permits us to give customized proposals to our learners in view of the inclinations and conduct of comparable learners. This approach uses cooperative learning and use the Python libraries like Pandas and Surprise. We additionally use Django Celery and signals to computerize and improve the recommendation process.

The following is the output our learner will be able to visualize the concepts recommended to them based on the collaborative filtering technique we have used.



Figure 2: User's Collaborative Recommendations

4.3 Personalized Recommendation

In our e-learning web app, we have implemented a content-based recommendation system for personalized recommendations. The code we have used for this recommendation system has several key components.

We applied a text transformation to the meaning of every concept utilizing the `transform()` capability. We then use `CountVectorizer()` to change over the transformed text into a lattice of token counts. `CountVectorizer` is a class from the `scikit-learn` library in Python that is utilized for text handling and component extraction. It changes over an assortment of text records into a network of token counts. In our code, we use `CountVectorizer` to transform the meanings of the ideas into a network of token counts so we can look at them utilizing cosine likeness.

We then, at that point, compute the cosine similarity between each sets of concepts utilizing the `cosine_similarity()` capability. The outcome is a grid of similitudes between all sets of concepts. Cosine similarity is a proportion of similarity between two non-zero vectors of an inward item space. In our code, we use `cosine_similarity` from the `scikit-learn` library to figure the cosine similarity between the vectorized concept definitions. This is finished to find the similarity between the

concepts considering their definitions, and to prescribe concepts that have comparable definitions to the concepts that the client has proactively passed.

We convert this matrix into a dictionary, where each key corresponds to a concept ID, and each value is another dictionary where the keys are concept IDs, and the values are their corresponding similarity scores.

Overall, this content-based recommendation system uses the text data associated with concepts to generate personalized recommendations for individual learners. By focusing on concepts that are similar to those that a learner has already mastered, we aim to provide them with recommendations that are relevant and engaging.

This will be the output which will be displayed to the learner after the complete processing of our content-based recommender system.

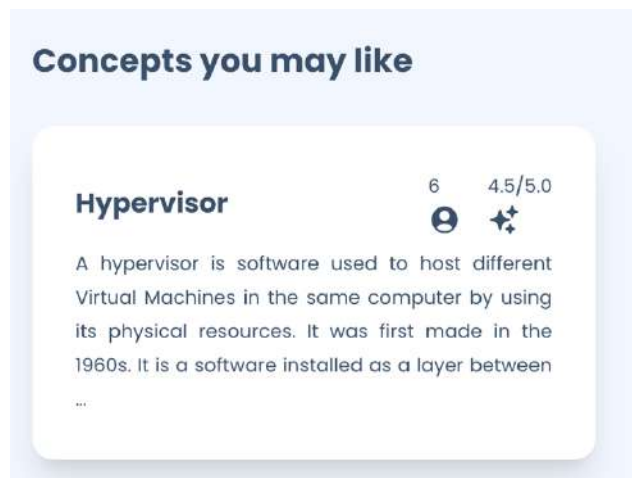


Figure 3: User's Personalized Recommendation

4.4 Personalized Learning Path

The personalized learning path tracks the learner's progress by recording the concepts they have passed and the ones they still need to cover. It also provides visual displays of recommended concepts based on their past performance, interests,

and learning goals. This allows learners to focus on topics they need to master, rather than wasting time on concepts they already understand.

In addition, our platform uses dynamic profiling to continually update and adapt the personalized learning path based on the learner's performance and feedback. This includes factors such as their level of engagement, learning style, and pace of progress. By collecting and analyzing this data, we can make adjustments to the learning path to ensure that each learner is challenged appropriately and stays motivated.

This personalized approach to learning has several benefits. It allows learners to focus on their individual needs and interests, which can increase their engagement and motivation. It also ensures that they have a clear understanding of what they have learned and what they still need to master, which can improve their overall performance and knowledge retention. Finally, dynamic profiling ensures that the learning path is continually updated to meet the learner's changing needs, which can help them achieve their goals more efficiently and effectively.

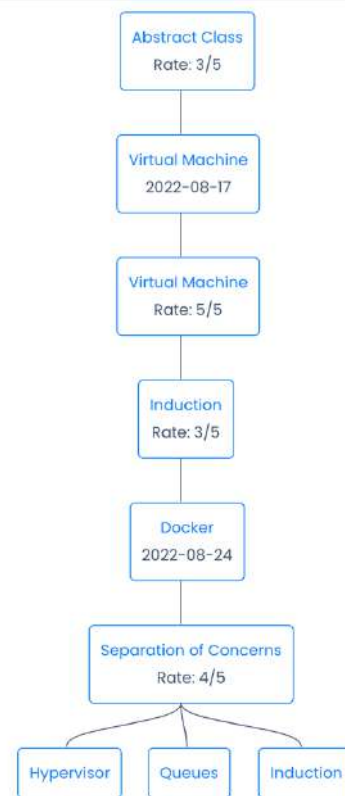


Figure 4: User's Roadmap

4.5 Cold Start Problem

The cold start issue alludes to the issue of making suggestions for new clients or things with restricted or no accessible information. Essentially, the system has no information on the preferences or characteristics of these new users or items, making it difficult to provide relevant recommendations. This can result in poor user

experience, low engagement, and ultimately, reduced effectiveness of the recommendation system.

To address cold start issue, we are utilizing the Gunning Fog File to dissect the intricacy of the text of the concepts and their portrayals. The Gunning Fog Record is a coherence metric that computes the quantity of long stretches of instruction an individual necessity to grasp a specific piece of text. It utilizes an equation that considers the typical sentence length and the level of words with at least three syllables to gauge the trouble level of the message. The file goes from 0 to 20, with 20 being the most challenging to comprehend.

We are using the Gunning Fog Index to analyze the complexity of the concept definition and description text in our website. We calculate the index for each concept and then map it onto the qualification level of the learner. This mapping helps us to recommend concepts that are appropriate for the learner's level of understanding.

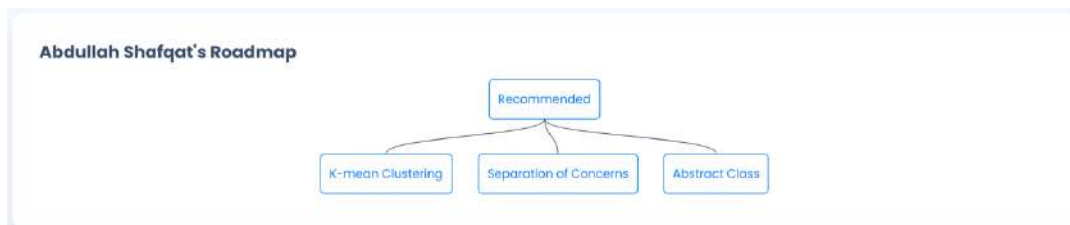


Figure 5: New User's Roadmap

The formula for gunning fog index is given as:

$$= 0.4 * \left[\left(\frac{\text{total words}}{\text{total sentences}} \right) + 100 \frac{\text{complex words}}{\text{total words}} \right]$$

For example, suppose a concept has a Gunning Fog Index of 12. This means that the concept's definition and description are written at a level that requires at least 12 years of education to understand. If the learner's qualification level is 10 years of education, then we will not recommend this concept to the learner because it is too difficult for their level of understanding.

4.6 Smart Assessment

In our e-learning web app, we have implemented a set of features we call Smart Assessment. Smart assessment includes smart fill-in-the-blank questions and smart short question answer.

The smart fill-in-the-blank questions allows users to test their understanding of the material by filling in the empty blank, which is then automatically checked to see if it matches the correct answer in an intelligent way. To achieve this, we initially apply Fuzzy Wuzzy matching on the client's response. Fuzzy Wuzzy is a Python library that utilizes Levenshtein Distance to work out the distinctions between successions. It gives a proportion of how comparative two strings are, permitting us to contrast the client's response with the right response.

If the Fuzzy Wuzzy matching determines that the user's answer is a close enough match to the correct answer, the user is assigned a grade. However, if the match is not close enough, we use OpenAI API to search through a powerful prompt to determine whether the user's answer is appropriate or not. OpenAI API is a powerful artificial intelligence tool that allows developers to integrate natural language processing, machine learning, and other advanced AI capabilities into their applications.

The short questions answers present the user with a set of 5 questions which must be answered by the user in a corresponding text box. The questions are generated dynamically at each runtime which increases the probability of getting new questions each time around. For generating the questions OpenAI API is prompted with a highly engineered and tested prompt to get a response. This response in turn is preprocessed to extract useful information to display on the UI.

Grading the answers to these short questions works using the OpenAI API as well. The answer along with the question and the concept description are sent as context to the API. Sending the concept ensures that the LLM working behind the

API does not use its entire knowledge base which slows down response time and also increase unreliability rather only keeps the current concept in view. The output received by the API is run through a set of process to transform it into usable information and then is displayed to the user in a well formatted UI.

Using Smart Assessment provides users with immediate feedback on their understanding of the material and allows them to improve their understanding before moving on to new topics.

4.7 Gamification

This feature is designed to engage the learners and contributors by assigning badges to them as they progress through the courses and contribute to the platform. The badges are awarded based on certain milestones, such as completing a certain number of courses or contributing a certain amount of content. The badges are designed to provide a sense of achievement and recognition to the learners and contributors.

By assigning badges, we aim to motivate the learners and contributors to stay engaged with the platform and continue their learning journey. This feature also fosters a sense of competition and community among the learners, which encourages them to engage with the platform more frequently.

The badge system is visible on the user's profile, which adds to the user's sense of achievement. Overall, we believe that gamification is a powerful tool for engaging learners and contributors and fostering a sense of community on our e-learning platform.

Learner Badge

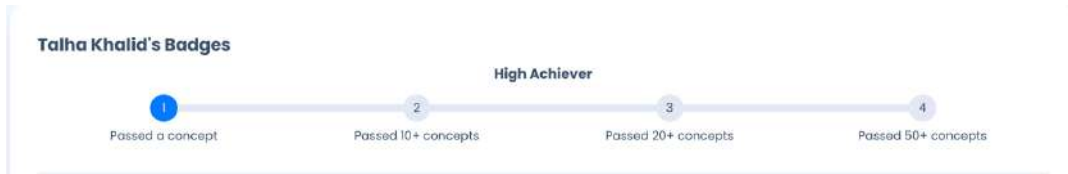


Figure 6: Learner User's Badges

Contributor Badge



Figure 7: Contributor User's Badges

4.8 Ontology

The system incorporates a dynamic concept ontology tailored to each user's chosen topic within a specific domain. Whenever developers introduce new concepts to the platform, the ontology graph is automatically updated. This functionality enables users to visualize the different groups in which the content is organized, providing them with a comprehensive overview of their future learning opportunities.

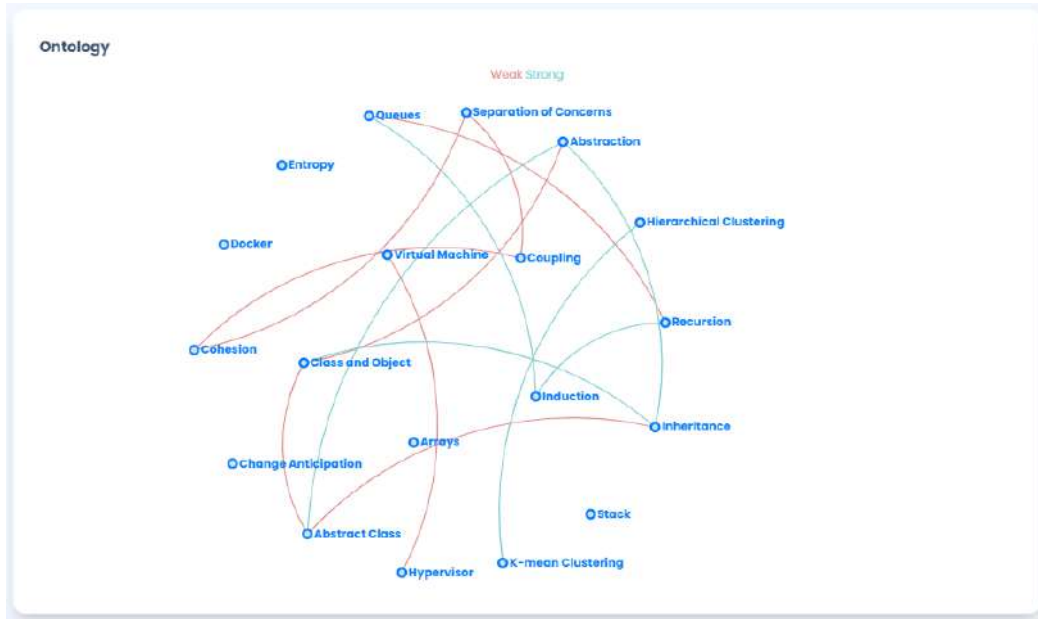


Figure 8: Ontology Interlinkages Graph

4.9 STEM Hierarchy

This feature that provides users with a comprehensive and visual representation of the entire STEM (Science, Technology, Engineering, and Mathematics) landscape on our site. This feature leverages the existing STEM fields, their associated domains, courses, and concepts, to create an interactive tree structure.

The methodology behind the STEM Hierarchy involves aggregating all the available STEM fields, domains, courses, and concepts present on the site. By organizing this information in a hierarchical manner, we enable users to easily navigate and explore the vast realm of STEM subjects.

With the STEM Hierarchy, users have the ability to expand and collapse each level of the tree at their convenience. This functionality allows them to delve into specific domains, explore associated courses, and further uncover the underlying concepts. By expanding or collapsing different branches of the tree, users can

dynamically visualize the entire layout of STEM on our site, gaining a holistic understanding of the subject matter.

This feature serves as a valuable tool for users to plan their learning journeys, identify knowledge gaps, and explore new areas of interest within the STEM disciplines. The interactive nature of the STEM Hierarchy fosters a seamless and intuitive user experience, enhancing engagement and facilitating efficient exploration of the vast knowledge available on our platform.

By providing a clear and structured overview of STEM fields, domains, courses, and concepts, the STEM Hierarchy empowers users to navigate the diverse landscape of STEM education, enabling them to make informed decisions about their learning paths. It serves as a guiding framework that promotes discovery, curiosity, and a deeper understanding of the interconnectedness of STEM subjects.

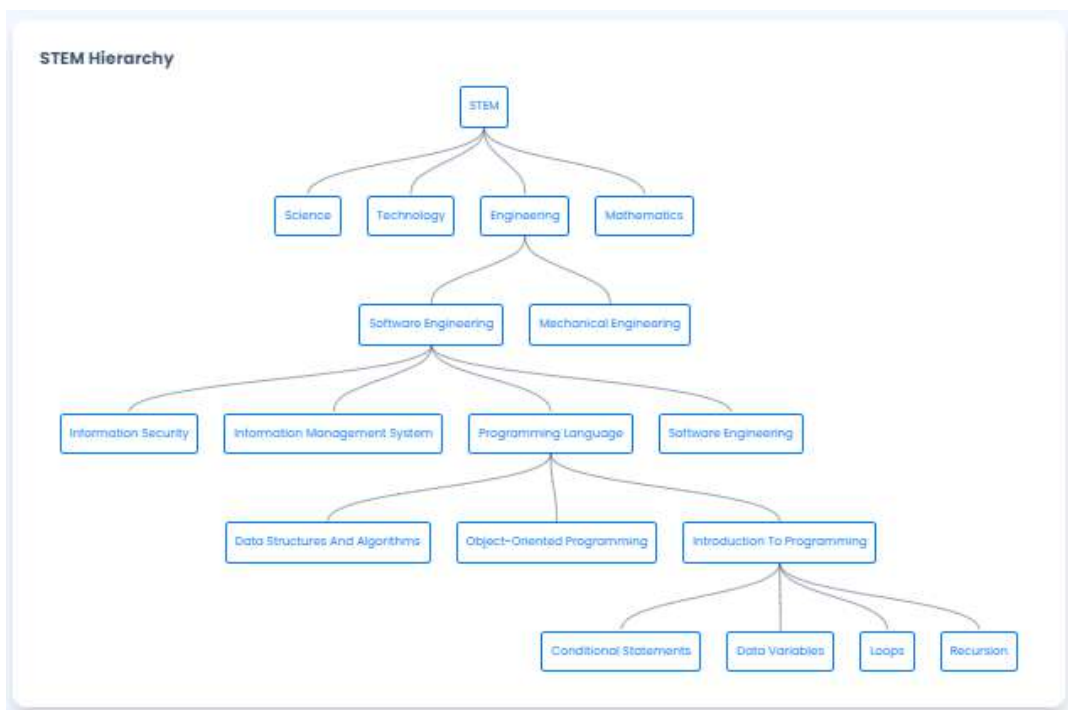


Figure 9: Stem Hierarchy Tree

SOFTWARE REQUIREMENT SPECIFICATIONS

In this section, we present the Software Requirement Specifications (SRS) for Grepbing. The following outlines the functional and non-functional requirements, system architecture, and user interface specifications, paving the way for the successful development and implementation of Grepbing.

5.1 Requirements Elicitation

This feature that provides users with a comprehensive and visual representation of the entire STEM (Science, Technology, Engineering, and Mathematics) landscape on our site. This feature leverages the existing STEM fields, their associated domains, courses, and concepts, to create an interactive tree structure.

5.2 External Interface Requirements

5.2.1 User Interfaces

1. When the user types in the URL for the application, they land on the home screen of the website
2. From this page, the user can access the tutorial, access the website in guest mode and sign in. If the user scrolls down, they can see the facts about GrepBing and view the concept of the day.
3. When the user clicks on the sign-in page they can enter their credentials and sign in.
4. If the user doesn't have an account, they can enter their details and create their account. The account must be approved before it can be used.
5. The admin can view the statistics by login in.
6. The admin can view, activate, and deactivate accounts

7. The contributor can add concepts
8. The contributor can add concept attributes
9. The contributor can add questions to the quiz
10. The contributor can add quizzes to the concept
11. The learner can view their grades after attempting the quiz

5.2.2 Hardware Interfaces

Since the application is operated over the internet, the user must have a device that supports internet access and related protocols.

5.2.3 Software Interfaces

The application requires a web browser to operate.

5.2.4 Communication Interfaces

Https with default port 443 is used. SSH over default port 22 is used to connect server to the remote machine.

5.3 System Features

5.3.1 Login/Signup

Introduction:

Data Integrity is assured by using sessions and requests made by the user. For proper maintenance of data user must be logged in using proper credentials.

Response Sequence

The user will click on the login/signup button. If they already have an account, they can log in otherwise they can sign up by entering the credentials. After the user clicks on the sign-up button, they can access the functionality of the website after their account gets approved by admin.

Associated Functional Requirement

1. The user must sign-up to access the full functionality of the application.
2. Old users should enter credentials to login
3. Contributors should enter their bank account details at the time of Sign Up for their payments related to concepts.
4. Users will be able to view the brief about the STEM concepts without authentication. Other roles must sign up / login to get their tasks done, which will be explained in the sections later.
5. The user should not have multiple accounts for the same category with the same email and contact
6. Learners and contributors have the same account by default, they should easily switch between their roles.

5.3.2 View Content as Guest User

Introduction

The non-registered user can only view the content and cannot attempt any quizzes or keep track of their progress.

Response Sequence

The user can view the read-only areas of the application, either by going through the proper sequence of STEM or just by searching their relative concepts.

Associated Functional Requirement

1. Non-registered users must not be able to access contributor's details and quizzes.
2. They should not be able to view contributor and KGH details.
3. They should not be able to add comments to the concept
4. They should not be able to use system's main feature like ontology and smart search.

5. Their progress should not be saved in the database.

Associated Non-Functional Requirement

1. The access time for the content should be fast
2. The content should be easy to read and comprehend
3. The website should follow design principles of human-computer interaction

5.3.3 View Content as Registered Learner

Introduction

The registered user can access the full functionality of the application. The learner can keep track of the progress and attempt the quizzes. They can also get further recommendations for future concepts for better grip on their skills.

Response Sequence

When the user logs in a particular mode, they can access all the features available for that mode.

Associated Functional Requirement

1. Only the registered learners can access the quizzes and progress. The system should match the credentials before giving access to the quizzes.
2. The learner can see progress in a particular concept and observe their scores on a quiz.
3. The learners can also add comments under concepts i.e., any questions or ambiguities related to concepts.
4. The learners can rate a particular assessment
5. The profile of the contributor and knowledge group head is also visible to the learner
6. The time that a particular learner spends on a topic is also maintained
7. The learners also have the provision of bookmarking their favorite concepts

8. The concepts can also be shared on social media platforms.
9. 20 questions at a time should be presented to a learner
10. These questions should not repeat.

Associated Non-Functional Requirement

1. In case of refresh or internet issues, previous state should be maintained.
2. New questions should appear quickly, and the answers should be saved in minimal time

5.3.4 Add and Edit Content as a Contributor

Introduction

The contributor is the second most important role for the application. They are responsible for creating the content and the assessments. The contributors are paid Rs 500 per approved concept and in case they encounter three rejections consecutively, their account gets suspended.

Response Sequence

The contributor after logging in can create assessments, edit attributes, and access their wallet. They can also see the status of their concepts.

Associated Functional Requirement

1. The contributor must only create and update the attributes and assessments. They cannot delete the concept.
2. Contributors must be knowledge groups specific; they should have option to either switch the knowledge group or add more knowledge groups into their profiles.
3. Contributor must add concept attributes like definition, description and example before adding a quiz.
4. Contributor must add at least 50 questions in quiz, in order to send that concept for approval.

5. The contributor's account must get suspended after three consecutive rejections automatically
6. The contributor should be paid Rs 500 per approved concept

Associated Non-Functional Requirement

1. The contributor should receive the payment as soon as the concept gets approved
2. An easy-to-use interface that is suitable for designing assessments is essential for a contributor
3. The concept posted by the contributor must get approved within 72 hours

5.3.5 Approve or Reject Content as KGH

Introduction

The knowledge group head is responsible for approving the concepts posted by the contributors. They are experts in their domain and ensure the credibility and authenticity of the assessments and other content.

Response Sequence

The KGH can view the pending concepts and approved concepts when they log in. They can also request changes to the content from the contributors through their profile.

Associated Functional Requirements

1. KGH must be able to approve and reject concept accordingly.
2. They must also ask for revision on a particular concept
3. They must view all attributes and questions of the quiz of concept
4. They should receive notifications and email for the pending concepts.

Associated Non-Functional Requirements

1. The KGH cannot access the domains of other KGHs

2. The KGH must approve a concept in 72 hours, otherwise, they will get a warning
3. The KGH must give at least 10 minutes to each pending concept for approval

5.3.6 Manage the Domains as SME

Introduction

Each domain of STEM has a Subject Matter Expert that is responsible for that domain. They are responsible for concept creation.

Response Sequence

The SME after logging in can access all the concepts and their associated KGH. They can make changes to the concept from their portal.

Associated Functional Requirements

1. The SME must be responsible for the creation of domains.
2. SME should be able to switch domain of internal courses.
3. They hold all the privileges regarding a domain such as creating, updating, and deleting.

Associated Non-Functional Requirements

The SME for a particular domain cannot make changes to other domains. If they try to do so they will get a 403 error.

5.3.7 Performance of administrative duties as Admin

Introduction

The admin is the super user of the application. They have the access to all the information that is stored in the database. They are responsible for performing managerial duties.

Associated Functional Requirements

1. The admin should have all the access privileges to view, change, delete or add data in the database
2. In the case of multiple admins, they should have separate credentials
3. Unapproved accounts and pending balances should be shown in the notification panel
4. The balance of a particular contributor and profile score should be visible

5.3.8 Intelligent Assessment

Introduction:

Learners are assessed about their skills by intelligent assessment created by contributors with a question bank of at least 50 questions per concept.

Response Sequence:

Learners will be able to attempt the quiz after viewing the concept.

Associated Functional Requirements:

1. Contributor must be able to add 3 types of questions, True/ False, MCQs (single and multiple options), Fill in the blanks.
2. System must be able to detect similar answers in case of fill in the blanks.
3. Contributor answering similar answers in fill in the blanks should be marked as true.
4. Final Assessment for the course completion certificate should consist of all the questions learner failed.

5.3.9 Recommender System

Introduction:

System will recommend concepts and courses to learners based on his activities.

Response Sequence:

Learner will be able to view the recommended concepts/ courses on navbar.

Associated Functional Requirements:

1. System should recommend concepts and courses to learners on two bases, content based, and user based.
2. In case of content-based recommender, system should match the tags of learner's passed concepts to other concept and recommend similar concepts
3. In case of user-based recommender, system should track path of learner's activity and recommend new concepts to learner based on this activity.

5.3.10 Smart Search**Introduction:**

User will be able to search the entire concepts on available on the website using search field available on every screen.

Response Sequence:

On every screen, a toast model will be present which will guide the user to concepts.

Associated Functional Requirements:

- Concepts presented in search model, should be role specific.
- Keyword searched should search all the attributes (title, definition, description) in the concepts and retrieve the concepts accordingly.

- Concept's title should be clickable and should lead to concept's view screen.

5.3.11 Concept Ontology

Introduction:

A concept ontology is developed for each domain at run time for each user according to their chosen topic.

Response Sequence:

In every screen, there will be a toast model, which will represent the concept ontology.

Associated Functional Requirements:

1. Concept Ontology should be updated at real time.
2. Ontology should be role specific i.e., learners must only see the approved concepts in ontology and admin must be able to view all the concepts.
3. Interlinkages of different concepts must be represented in ontology.
4. Concepts should be clickable and must lead to concept view screen.

5.3.12 Performance Requirements

The application is dependent on a browser for operation. Any machine that can run a web browser can support the operation of the application.

5.3.13 Safety Requirements

1. Users will be able to see only their content, they won't be able to get access of the other account and go through their account details.
2. HTTPS SSL certificate is maintained

3. Auto-renewal of certificate after 60 days is also implemented
4. The Passwords are hashed for safety

5.3.14 Security Requirements

The application is deployed on the cloud which is more secure

5.3.15 Software Quality Attributes

1. The application is usable by different demographic of users - Usability
2. The application is easy to maintain and follows 1 sprint per fortnight - Maintainability
3. The application is frequently tested for errors-Testability
4. The website is highly scalable -Scalable
5. The database avoids redundancy by using normalization till the fourth normal form -The normalized database

5.3.16 Business Rules

1. The clicks on the websites are used for revenue generation
2. Auto payment for contributors is implemented to attract more contributors.
3. The application has a visible ontology of the topics which helps the user to know what they have learnt and what else they need to know
4. Quizzes are assessed automatically.
5. A recommender system is implemented for registered learners

5.3.17 Other requirements

1. The application should be hosted on a platform that promises 99.9 % uptime
2. Copy/ paste must be disabled on the website.
3. Right click must be disabled on the website.

DETAILED DESIGN AND ARCHITECTURE

In this section, we provide an introduction to the design and architecture for our project. The SDS outlines the detailed design and architecture of the system, aiming to bridge the gap between the software requirements and its actual implementation. By presenting the system's design components, modules, and interactions, the SDS serves as a comprehensive guide for the development team, ensuring a well-structured and efficient system design. Additionally, the document highlights the design considerations, constraints, and methodologies employed during the system's development, laying the foundation for the successful realization of our project goals.

6.1 Design Methodology and Software Process Model

6.1.1 Assumptions

The accompanying assumptions were made during the plan of GrepBing:

User's Learning Inclination: We expected that the client's favored technique for learning is visual. This assisted us with planning a successful UI that meets the client's prerequisites and gives a drawing in and compelling learning experience.

User's Innovative Inclination: We expected that the client is a lot of acquainted with web and web-based learning. This assisted us with making a UI that is instinctive and simple to utilize, in any event, for the people who are new to web-based learning.

User's inspiration: We expected that client is propelled to propel his profession or to work on his abilities. This data assists the originators with

making a client experience that lines up with the client's objectives and gives the vital assets and backing to assist them with accomplishing their goals.

6.1.2 Constraints

The accompanying limitations were accepted during the plan of GrepBing:

Technical Requirements: We thought about the specialized constraints of the site, like similarity with various gadgets, programs, and working frameworks, and the accessibility of assets like data transmission. We planned a responsive UI which is effectively viable with portable, workstations or even huge work area screens. Client should have very great web to stay away from any burden in the ordinary usefulness of the site.

Time and spending plan Requirements: We have restricted chance to finish this task and the financial plan for the sending of our site.

Accessibility and comprehensive plan limitations: We additionally thought to be the openness and comprehensive plan imperatives, guaranteeing that the site is available to clients with inclinations with light and dull mode. We made two different variety beds for our clients. One is the light and the other one is dull, so the clients may not feel trouble to utilize the site around evening time.

6.1.3 Design Methodology

We settled on the choice to utilize a combination of item situated programming (OOP) and procedural programming for its execution.

OOP is a strong programming worldview that advances particularity, embodiment, and code reuse, making it appropriate for complex applications like Grepbing. By embodying information and conduct inside objects, we

had the option to make a reasonable and viable codebase that is straightforward and change on a case-by-case basis. In the perspectives area (center usefulness), we utilize classes and articles which makes it generally simple to execute APIs for the application.

Simultaneously, procedural writing computer programs is a time-tested approach that has been broadly utilized in the improvement of numerous effective applications. This approach is centered around the execution of methods, or capabilities, that perform explicit errands. We found that utilizing a mix of OOP and procedural programming permitted us to exploit the qualities of the two standards, bringing about a very much organized and productive codebase.

Our utilization of a combination of OOP and procedural programming has assisted us with conveying a top-notch e-learning stage that addresses the issues of its clients and gives a vigorous and versatile starting point for future turn of events.

As well as following this plan procedure, we likewise utilized the Strong standards and configuration examples to guarantee the quality and practicality of the code. For instance, we utilized the Single Liability Guideline to guarantee that every part had an unmistakable and clear-cut liability, and the Manufacturing plant Technique example to make objects in a reliable and adaptable way.

By utilizing Strong standards and configuration designs, we had the option to convey a top-notch site that addressed the issues of the clients and will give a compelling and drawing in learning experience.

6.1.4 Software Process Models

We utilized the Agile software process model for the advancement of GrepBing. The Agile philosophy underscores on iterative and steady methodology, close cooperation between the improvement group and partners, and the capacity to adjust to changing necessities all through the venture.

During the advancement of GrepBing, we followed the Agile standards and held customary runs to convey useful augmentations of the item toward the finish of each run. We monitored progress and resolved any issues that emerged.

We additionally elaborate partners in the improvement process by consolidating their criticism during run reviews and integrating their criticism into the following run. This assisted us with guaranteeing that GrepBing met their necessities and was created in a manner that was lined up with their assumptions.

By following the Agile technique, we had the option to convey a top-notch item inside the ideal timetable while having the option to answer changing prerequisites and integrate stake.

6.2 System Overview

The site is fabricated utilizing the Model-View-Format (MVT) engineering, a software configuration design that isolates the application into three interconnected parts: the model, the view, and the layout.

The model addresses the information and the business rationale of the application, taking care of all associations with the data set and different information sources. The view is liable for delivering the information, introducing it to the client in an easy-to-use design. The format characterizes the design and design of the site and gives a steady look and feel for all pages.

By utilizing the MVT engineering, the site will be adaptable, versatile, and simple to keep up with, considering speedy and consistent updates and enhancements.

6.2.1 Architectural Design

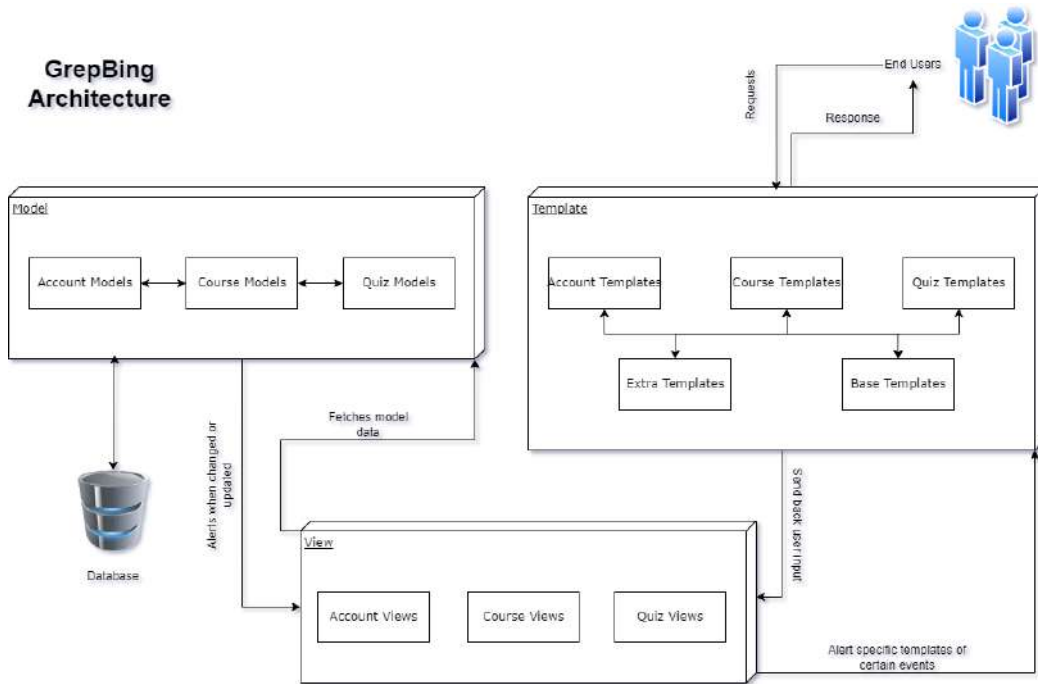


Figure 10: Architecture Diagram

6.3 Design Models

6.3.1 Class Diagrams

Accounts

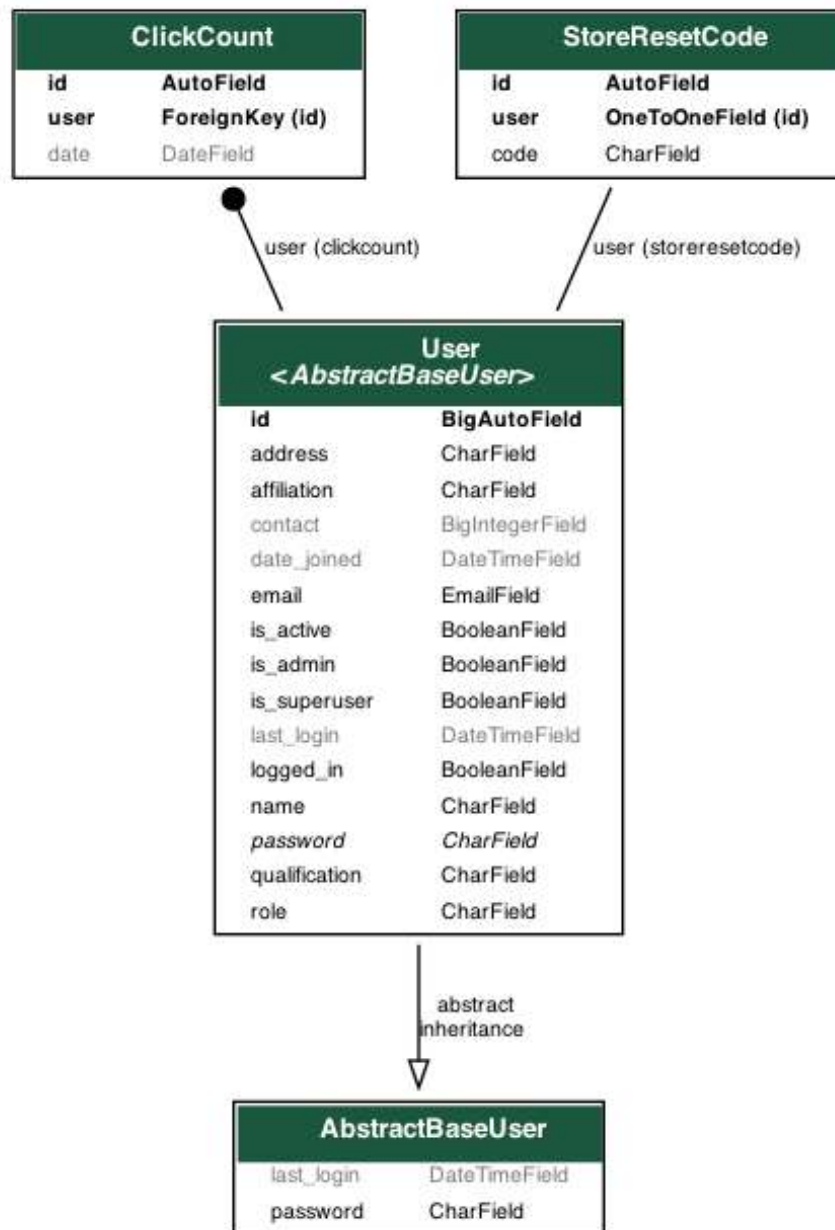
ClickCount: This class is liable for following and putting away the quantity of snaps made by a client on the site. It has `userId` as an unfamiliar key to allude to a specific client and stores a date against each snap by a client. For deciding perspective depends on a particular concept.

StoreResetCode: This class is liable for putting away and dealing with the reset codes that are created assuming a client attempts to reset their secret word. It has `userId` as an unfamiliar key.

AbstractBaseUser: This is a theoretical class that fills in as a base class for different classes in the framework. It gives a typical connection point and usefulness that can be shared by various classes. For this situation, the Client class acquires from the `AbstractBaseUser` and carries out the important strategies and traits intended for the client information.

User: This class addresses a client of the site and acquires from the `AbstractBaseUser` class. It has characteristics, for example, name, email, job,

capability, and secret word to store client data, and techniques to deal with



the client information.

Figure 11: Account Class Diagram

Quizzes

Answer: This class addresses an answer to a question and has traits, for example, answer to store the answer text and is_correct to show if the answer is right. It might likewise have strategies, for example, check_answer() to

confirm assuming the answer is right. It has question as an unfamiliar key to allude to a particular Question.

Score: This class addresses a score in the quiz and has traits, for example, FloatField score to store the score esteem and total_marks to store the greatest conceivable score. It might likewise have strategies, for example, calculate_percentage() to compute the score as a rate. It has quiz as an unfamiliar key to allude to a particular Quiz, and furthermore has a learner as an unfamiliar key to interface a score with a Learner.

Question: This class addresses a question in the quiz and has traits, for example, depiction to store the question text. It has quiz as an unfamiliar key to allude to a particular Quiz.

Quiz: This class addresses a quiz and has traits, for example, name to store the name of the quiz and timelimit to store the maximum time considered this quiz. It might likewise have techniques, for example, take_quiz() to start the quiz and get_score() to recover the score after the quiz is finished. It has

concept as an unfamiliar key to allude to a particular Concept.

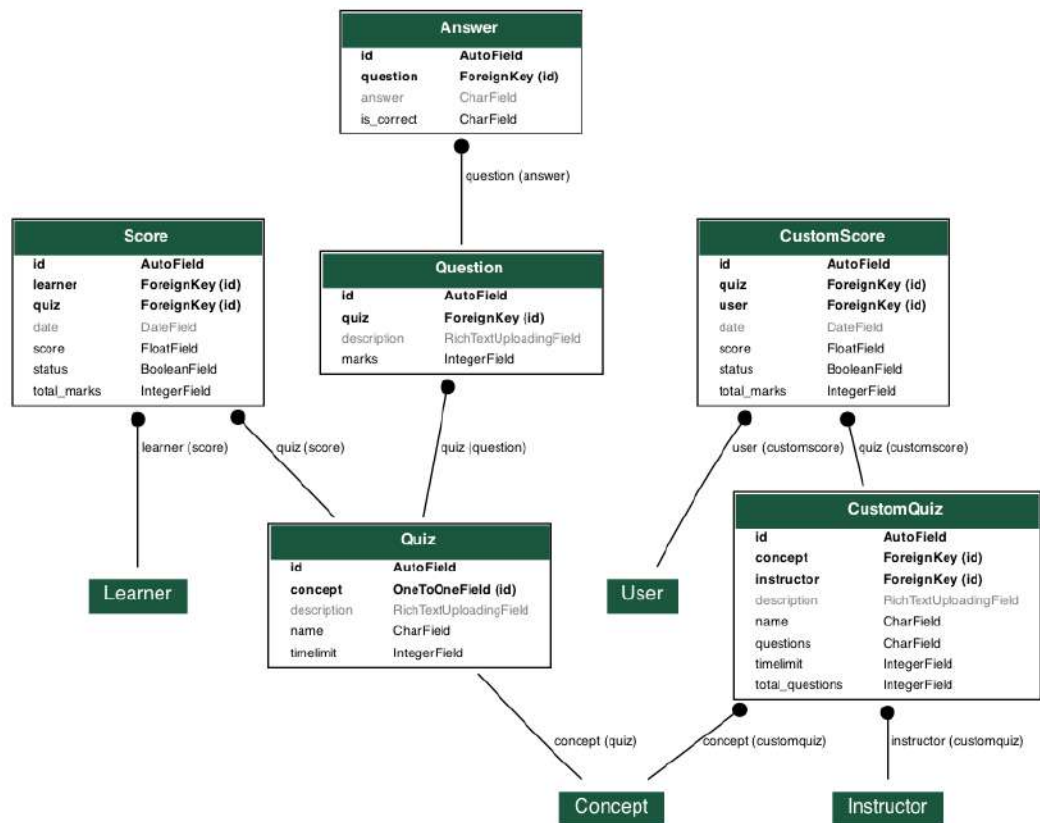


Figure 12: Quiz Class Diagram

Courses

Comments: This class addresses a remark on a specific concept by a user. It has characteristics, for example, text to store the text of the remark and creator to store the creator of the remark. The creator is an unfamiliar key to a User. One more unfamiliar key is concept which alludes to a Concept.

Status: This class addresses the status of a concept of a course for a client. It supported as an unfamiliar key to interfacing it to a User to check regardless of whether their concept is endorsed.

Concept: This class addresses a concept in a course. It has characteristics, for example, depiction to store the name of the concept, portrayal to store a portrayal of the concept, date_created and date_modified fields to store the

time data for that concept. It connects to Status, Contributor by utilizing unfamiliar keys status and contributor separately.

ImageModel: This class addresses a picture in the course. It has traits, for example, picture to store the picture information and subtitle to store an inscription for the picture.

Example: This class addresses an example in a concept. It has characteristics, for example, text to store the text of the example and picture to store the related picture.

ReceiptModel: This class addresses a receipt for an installment made for a course. It has traits, for example, add up to store the sum paid and date to store the date of the installment.

Course: This class addresses a course in the e-learning stage. It has characteristics, for example, title to store the name of the course, knowledge_group as an unfamiliar key to interface it to a KnowledgeGroup, and portrayal to store insights concerning the course.

KnowledgeGroup: This class data district. It connects with a space and has a depiction and a title.

User:

Every one of the accompanying classes are expanding User:

Contributor: This class addresses a contributor to the course. It has properties, for example, accountName to store the name of the contributor and accountNumber and bankName to wire installments to contributors on supported ideas.

Learner: This class addresses a learner who is taking the course. It has properties, for example, user to allude to a User class a float field positioning to store the remaining of the learner at the ongoing moment.

Instructor: This class addresses an instructor who is showing a course. It has qualities, for example, user to allude to a User class.

SubjectMatterExpert: This class addresses a well-informed authority who adds to the course satisfied. It has properties, for example, name to store the name of the master and space to store their subject matter. It has user as a foreign key to allude to a User class.

KnowledgeGroupHead: This class addresses the top of an information bunch, which connects to a KnowledgeGroup utilizing a foreign key. It has user as a foreign key to allude to a User class.

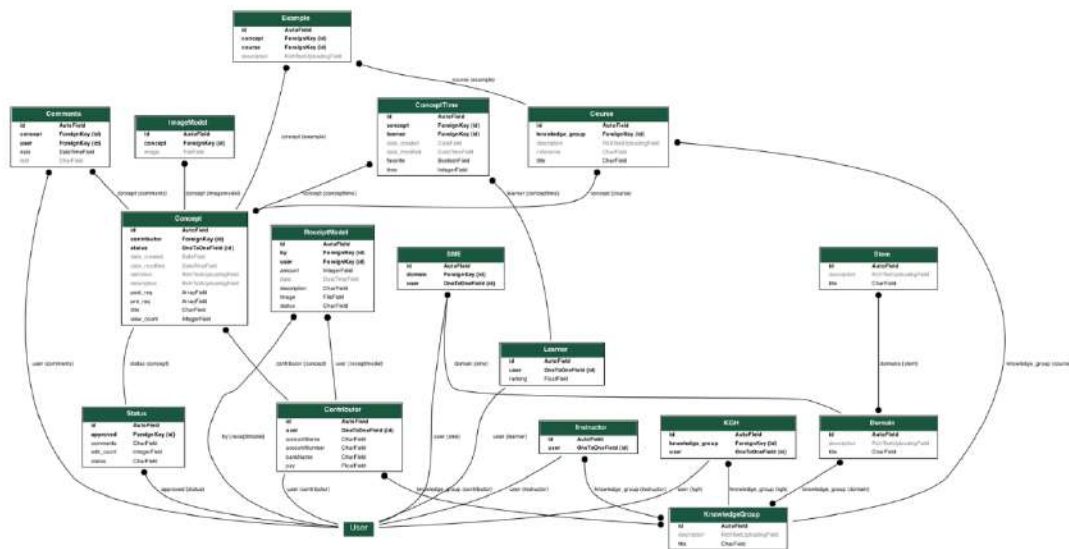


Figure 13: Course Class Diagram

6.3.2 Sequence Diagrams

The accompanying grouping graphs are addressing and depicting the collaborations and stream of messages between items or parts in a GrepBing. The connections between objects are being displayed in a consecutive request, from left to right, along a period pivot. Each item is addressed as an upward life saver, and the messages traded between the articles are addressed as flat bolts interfacing the life savers. The messages can address technique calls, occasions, signals, or different

sorts of cooperations between the items.

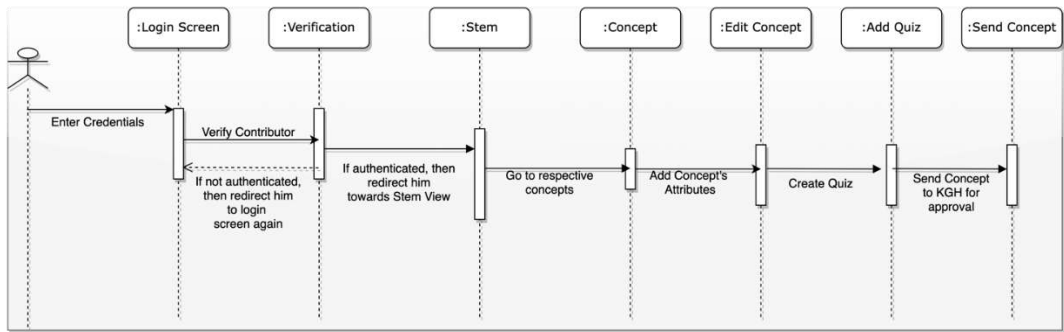


Figure 14: Contributor Sequence Diagram

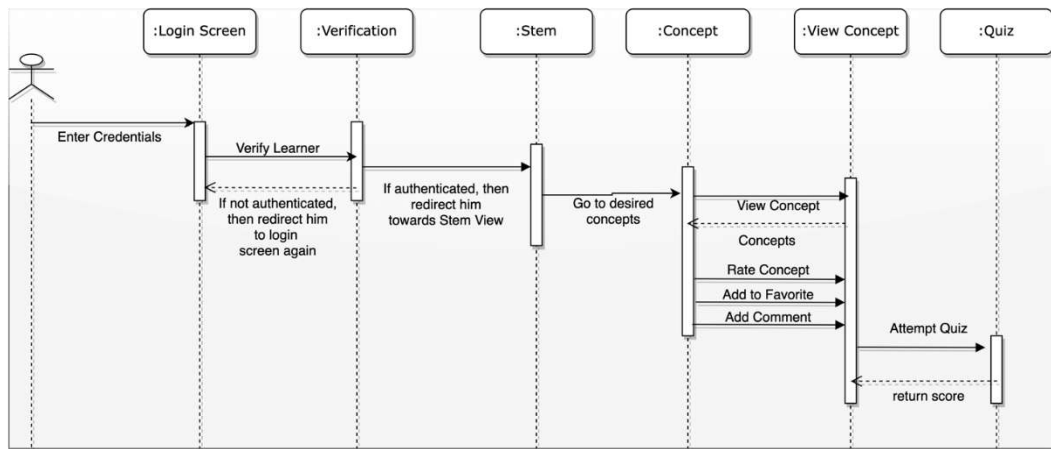


Figure 15: Learner Sequence Diagram

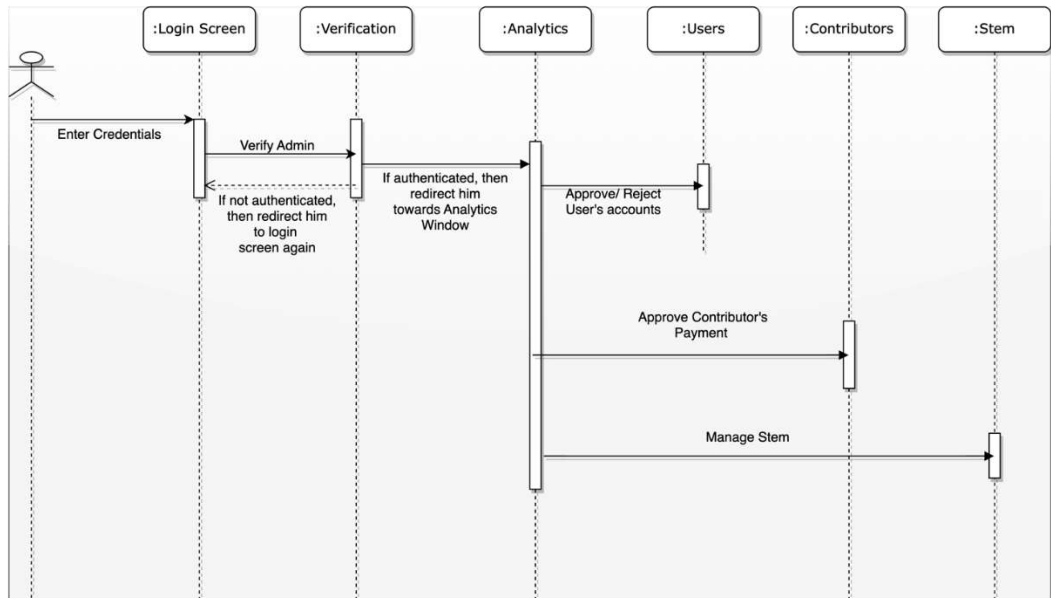


Figure 16: Admin Sequence Diagram

6.3.3 Activity Diagrams

The accompanying movement outlines are showing the progression of exercises connected with a specific element or cycle for GrepBing. Every hub in the graph addresses an activity or move toward the cycle, and the bolts address the progression of control starting with one activity then onto the next. The hubs are marked with

the name of the activity and any applicable information data sources or results.

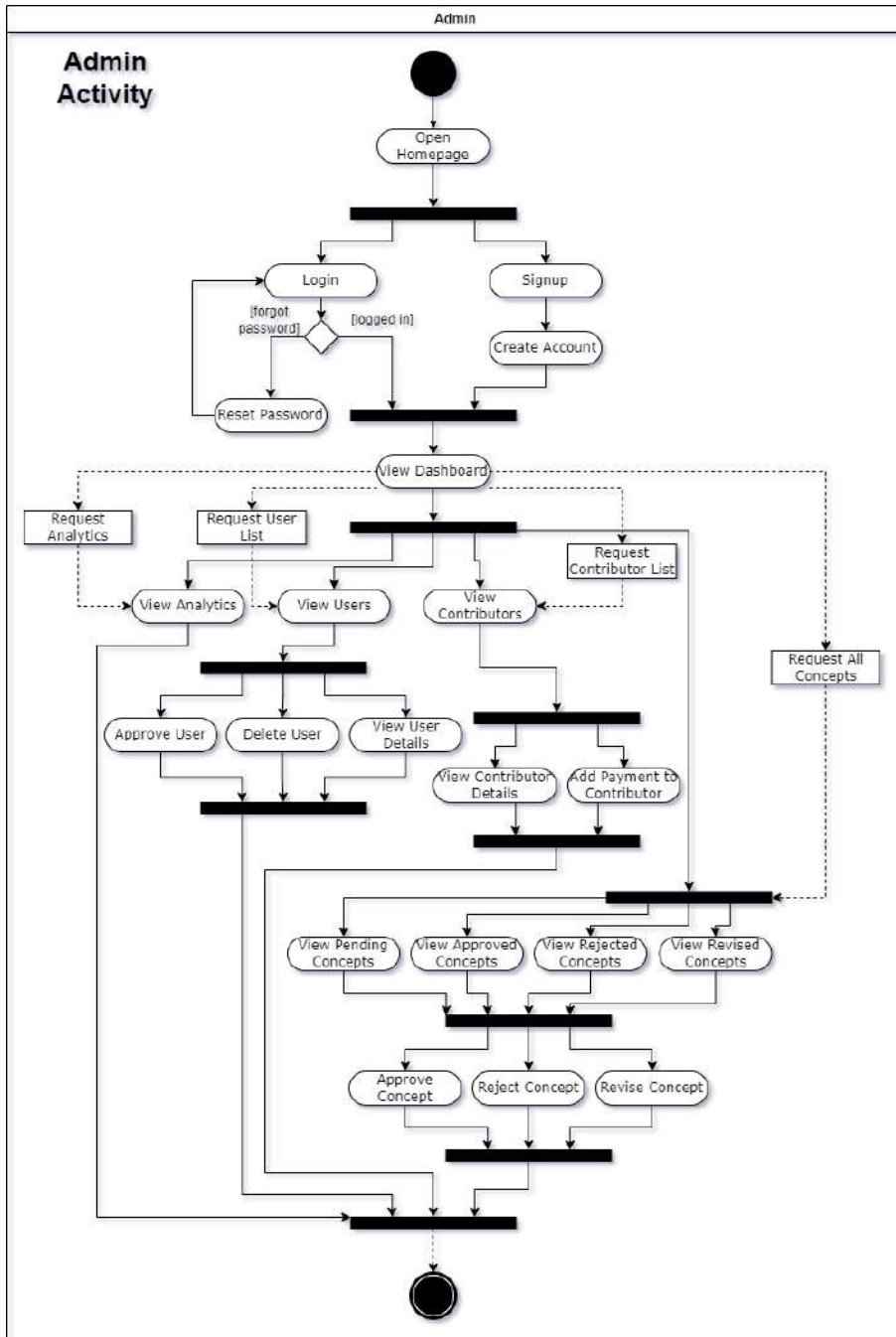


Figure 17: Admin Activity Diagram

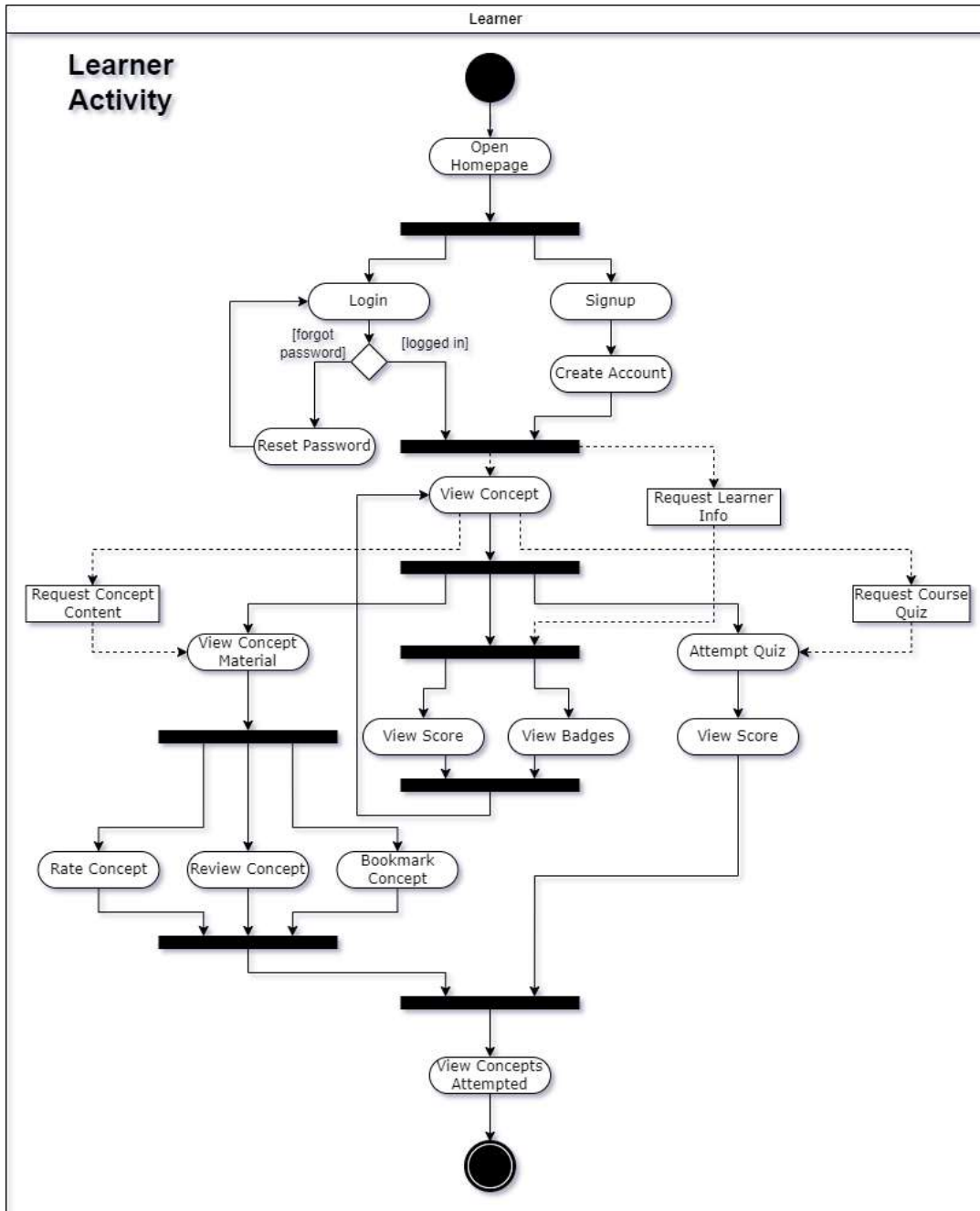


Figure 18: Learner Activity Diagram

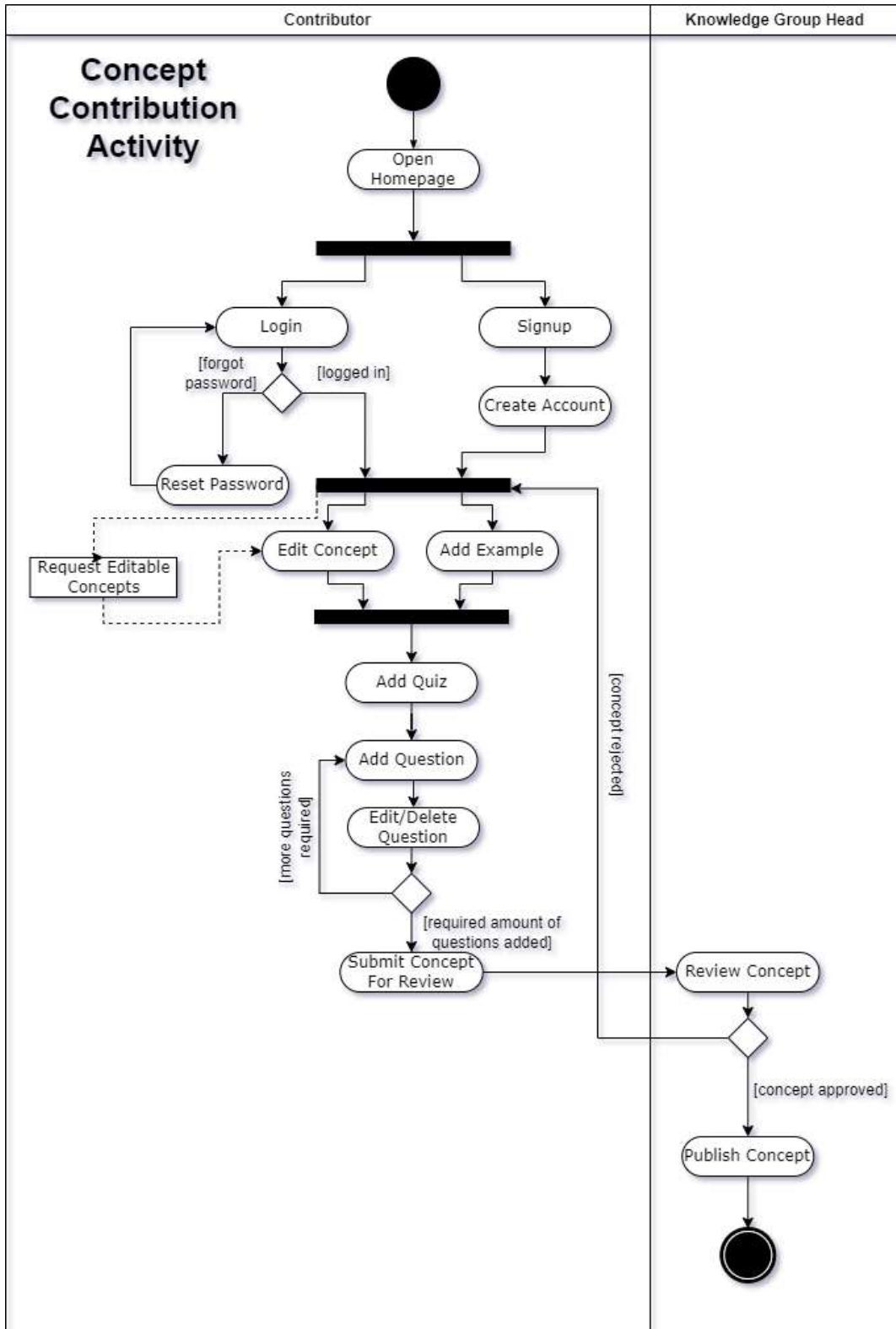


Figure 19: Concept Contribution Activity

6.4 Data Design

6.4.1 Database

We utilized PostgreSQL's capacity to deal with a lot of information and various simultaneous users, which pursued it a reasonable decision for a perplexing site that might get many demands and require quick reaction times. The information base's high-level ordering and question streamlining highlights permitted us to effectively look and recover information, giving a smooth and responsive user experience for the site's users.

Also, PostgreSQL's proficient stockpiling the executives' highlights assisted us with rationing space and lessen the expense of putting away a lot of information. The information base's help for cutting edge information types, for example, JSON and exhibits, additionally made it simpler for us to store and recover complex information structures, further improving the usefulness of our site.

Sequentially list the framework elements or significant information alongside their sorts and depictions. If you gave a practical portrayal, list every one of the capabilities and capability boundaries. Assuming you gave an OO portrayal, list the articles and its credits, techniques, and strategy boundaries.

6.4.2 Schema

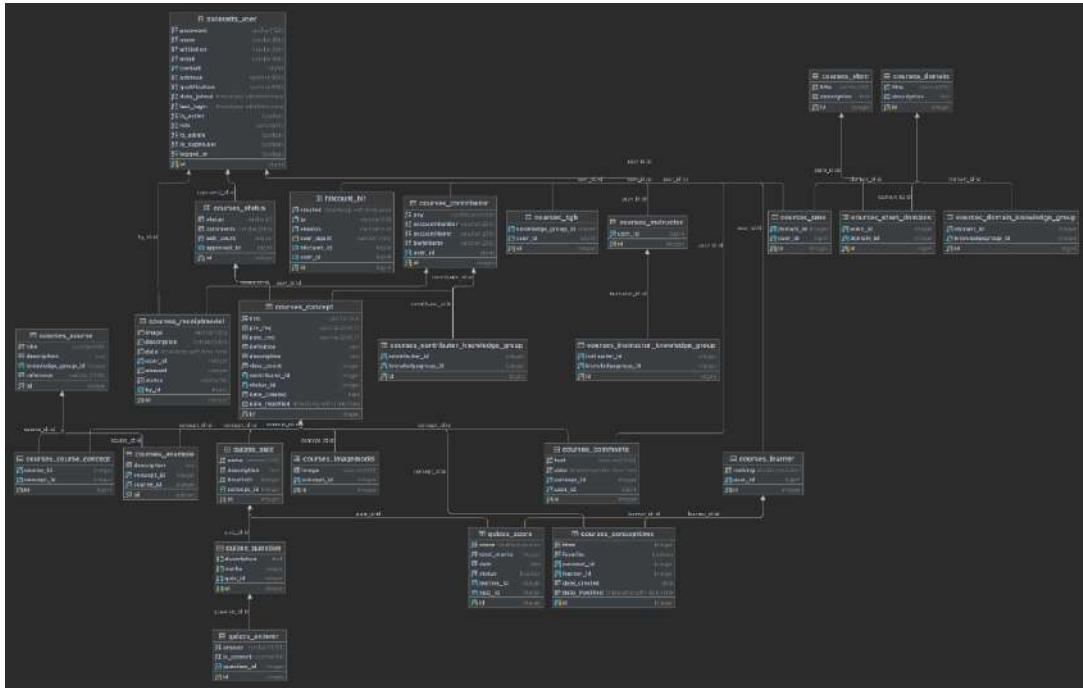


Figure 20: Database Schema

6.5 User Interface Design

GrepBing is planned with an emphasis on UI/UX (User Connection point/User Experience) to guarantee that it is not difficult to utilize and explore, while likewise being tastefully satisfying. The site consents to the standards of Human Computer Interaction (HCI) to guarantee that it is available and instinctive for users of any age and specialized foundations.

To meet these objectives, we have painstakingly viewed as the accompanying HCI rehearses:

- **Convenience:** The site is intended to be basic and direct, with clear and compact guidelines for each step of the educational experience. The site is additionally streamlined for various gadgets and screen sizes, to guarantee that it is usable on both work area and cell phones.

- **Openness:** The site is intended to be available for users thus numerous variety plans including a high-contrast variety plot are integrated.
- **Learnability:** The site is intended to be simple for users to learn and use, with a steady and natural route framework and clear, compact naming of buttons and connections. The site likewise remembers instructional exercises and assist assets with helping users for understanding how to utilize the different elements.
- **Criticism:** The site gives clear and quick criticism to users considering their activities, including mistake messages, progress markers, and affirmation messages. This assists with guaranteeing that users know about the situation with their activities and can rapidly address any missteps.
- **Style:** The site has an outwardly engaging plan, with a spotless and present day look and feel. The plan is steady across all pages and highlights, to assist users with feeling good and sure utilizing the site.

By considering these and other HCI rehearses, we intend to make a user-accommodating and open e-learning site that gives a positive encounter to all users.

SYSTEM TESTING

In this section, we discuss the testing carried out during the lifecycle of the project. System Testing focuses on evaluating the entire system as a whole to ensure that it meets the specified requirements and functions as intended. This phase involves executing a series of tests to validate the system's functionality, performance, reliability, and compatibility. By thoroughly examining the system under various conditions and scenarios, System Testing aims to identify any defects, inconsistencies, or gaps in the software, enabling the development team to make necessary improvements and deliver a high-quality, reliable, and user-friendly system to the end-users. The following subsections provide an overview of the testing approach, methodologies, and techniques employed to verify the system's behavior and assess its compliance with the defined specifications.

In our project Grepbing, we implemented unit testing as an integral part of our development process. Unit testing is a software testing method in which individual units, or components, of a program are tested to ensure that they function as expected. In Django, the popular Python web framework we used for our project, unit testing is supported through the built-in testing framework.

Throughout the development of Grepbing, we created and executed a total of 17-unit tests to verify the correctness and reliability of our code. These tests were designed to validate the behavior of individual components, such as models, views, forms, and utility functions, in isolation.

```
(KnowledgegePedia) talhapersonal@Talha-Khalid KnowledgegePedia % python manage.py test
Creating test database for alias 'default'...
2023-05-06 18:31:03.176161: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow
the following CPU instructions in performance-critical operations: AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
[nltk_data] Downloading package punkt to
[nltk_data] /Users/talhapersonal/nltk_data...
[nltk_data] Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to
[nltk_data] /Users/talhapersonal/nltk_data...
[nltk_data] Package stopwords is already up-to-date!
System check identified no issues (0 silenced).
.....
-----
Ran 17 tests in 3.789s

OK
Destroying test database for alias 'default'...
```

Figure 21: Successful Tests

One of the key advantages of unit testing is that it allows us to identify and fix bugs early in the development cycle. By isolating and testing individual units of code, we can catch issues before they propagate to other parts of the application. This helps maintain the stability and quality of the software.

Each unit test in our Django project was written as a Python function using Django's testing framework. We used various testing tools and techniques provided by Django, such as creating test cases, using assertions to verify expected outcomes, and setting up test data using fixtures or factories.

For example, in our unit tests for models, we ensured that the database schema and relationships were defined correctly, and that various operations, such as saving and retrieving data, behaved as expected. We also tested the validation rules defined in our models to ensure data integrity.

In addition to testing models, we also wrote unit tests for views to verify that the HTTP responses and template rendering were correct. We tested the behavior of our views under different scenarios, such as testing the handling of invalid input or authentication requirements.

Furthermore, we created unit tests for forms to validate input validation and error handling. By simulating user input and submitting forms, we ensured that our form handling logic was functioning correctly and providing the appropriate feedback to users.

The screenshot shows a 'Summary Report' interface with a table of test results. The table includes columns for Label, # Samples, Average, Min, Max, Std. Dev., Error %, Throughput, Received KB/sec, Sent KB/sec, and Avg. Bytes. The data is as follows:

Label	# Samples	Average	Min	Max	Std. Dev.	Error %	Throughput	Received KB/sec	Sent KB/sec	Avg. Bytes
home page	30	17518	6178	29958	8963.27	0.00%	51.9/min	44.57	0.23	52774.0
login	30	12698	2592	24694	6956.19	0.00%	56.6/min	24.92	0.35	27044.0
session-expires	30	5656	1245	28217	7403.38	0.00%	49.0/min	19.53	0.31	24459.0
smart-search	30	20935	3800	40128	13114.75	0.00%	42.0/min	29.92	0.28	43813.0
dashboard	30	13545	1005	36756	11860.91	0.00%	33.3/min	14.96	0.28	27827.0
stem	30	2394	971	8482	1969.57	0.00%	53.1/min	28.81	0.31	33327.0
users	30	4119	979	15009	4967.41	0.00%	49.5/min	22.23	0.40	27015.0
contributors	30	7034	894	17550	4941.49	0.00%	47.9/min	21.53	0.41	27536.0
concept	30	7418	2679	14749	3103.13	0.00%	46.0/min	41.11	0.19	54900.0
quiz	30	6415	1271	14500	2987.39	0.00%	45.7/min	20.55	0.37	27018.0
TOTAL	300	9773	894	40128	9333.36	0.00%	2.6/sec	87.24	1.02	34881.3

Figure 22: Tests Summary Report

The screenshot shows an 'Aggregate Report' interface with a table of test results. The table includes columns for Label, # Samples, Average, Median, 90% Line, 95% Line, 99% Line, Min, Maximum, Error %, Throughput, Received K..., and Sent KB/sec. The data is as follows:

Label	# Samples	Average	Median	90% Line	95% Line	99% Line	Min	Maximum	Error %	Throughput	Received K...	Sent KB/sec
home page	30	17518	19016	24162	28300	29958	6178	29958	0.00%	51.9/min	44.57	0.23
login	30	12698	11911	22238	22303	24894	2592	24694	0.00%	56.6/min	24.92	0.35
session-ex...	30	5656	2993	6457	27070	28217	1245	28217	0.00%	49.0/min	19.53	0.31
smart-search	30	20935	29047	37177	37413	40128	3800	40128	0.00%	42.0/min	29.92	0.28
dashboard	30	13545	8264	29314	30007	36756	1005	36756	0.00%	33.3/min	14.96	0.28
stem	30	2394	1099	3721	4786	8482	971	8482	0.00%	53.1/min	28.81	0.31
users	30	4119	1196	13078	14394	15009	979	15009	0.00%	49.5/min	22.23	0.40
contributors	30	7034	7643	12624	13924	17550	894	17550	0.00%	47.9/min	21.53	0.41
concept	30	7418	7200	12006	12118	14749	2679	14749	0.00%	46.0/min	41.11	0.19
quiz	30	6415	5670	10722	11046	14500	1271	14500	0.00%	45.7/min	20.55	0.37
TOTAL	300	9773	6670	24745	29850	37177	894	40128	0.00%	2.6/sec	87.24	1.02

Figure 23: Tests Aggregate Report

Throughout the development process, we continuously executed these unit tests to ensure that our codebase remained robust and reliable. Whenever a new feature or bug fix was implemented, we added corresponding unit tests to cover the new functionality and prevent regressions.

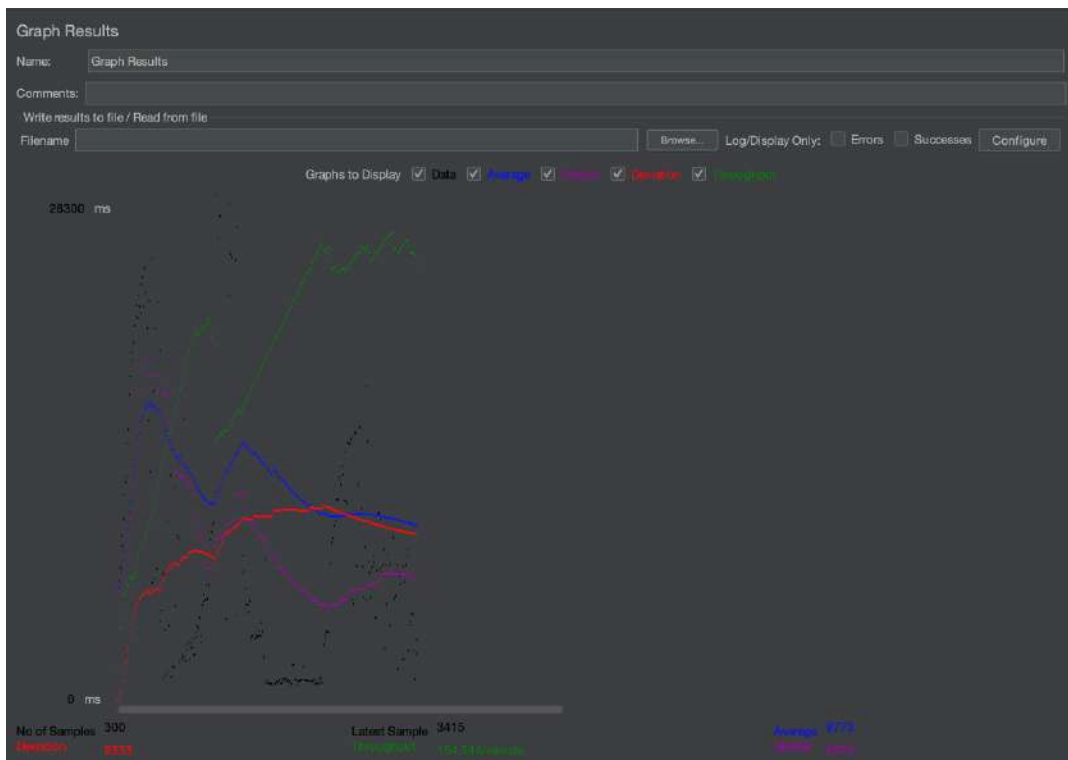


Figure 24: Tests Graph Results

DEPLOYMENT AND SYSTEM INTEGRATION

In this section, we present the Deployment and System Integration aspects of Grepbing, which are crucial for the successful implementation and operation of the system. Deploying and integrating a software solution involves various processes and considerations, including the installation and configuration of the system components, ensuring compatibility with existing infrastructure, and establishing seamless communication and interaction between different modules and external systems. This section outlines the requirements and guidelines for deploying Grepbing effectively, as well as integrating it into the existing system landscape, to ensure a smooth and efficient operation of the software.

We utilized Amazon Web Services (AWS) for deploying our website on the domain Grepbing.com. AWS provided us with a reliable and scalable infrastructure to ensure the smooth operation of our platform.

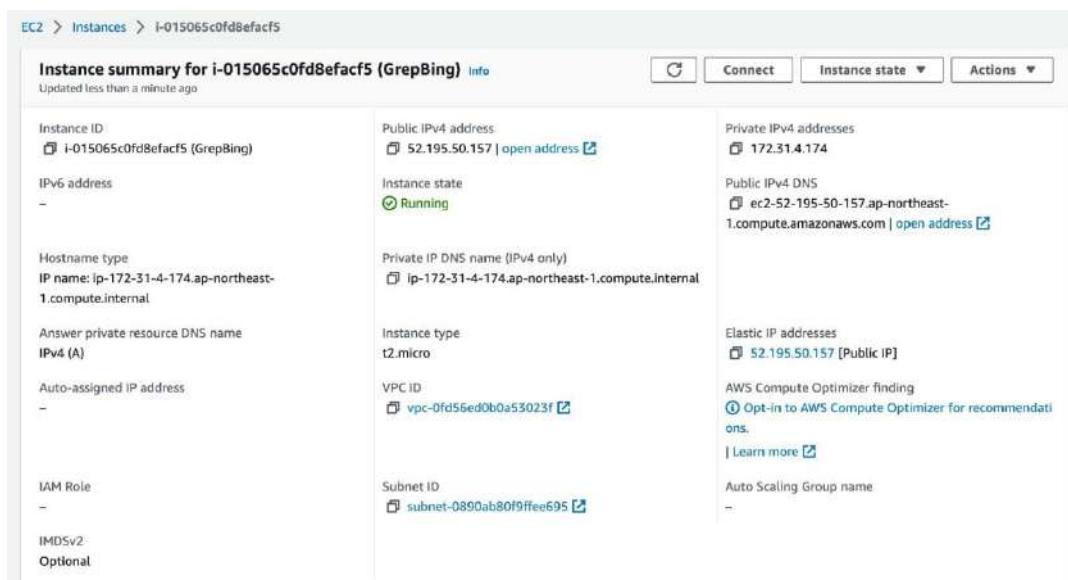


Figure 25: AWS EC2 Instance

Due to limited server memory, only 1GB of RAM, careful considerations had to be taken to evade potential bottleneck for handling the incoming traffic and executing resource-intensive tasks.

To tackle the memory constraint, we employed a combination of techniques. First, we optimized our code and made it more memory-efficient by carefully managing data structures and reducing unnecessary memory allocations. This helped us optimize the usage of available resources and minimize memory consumption.

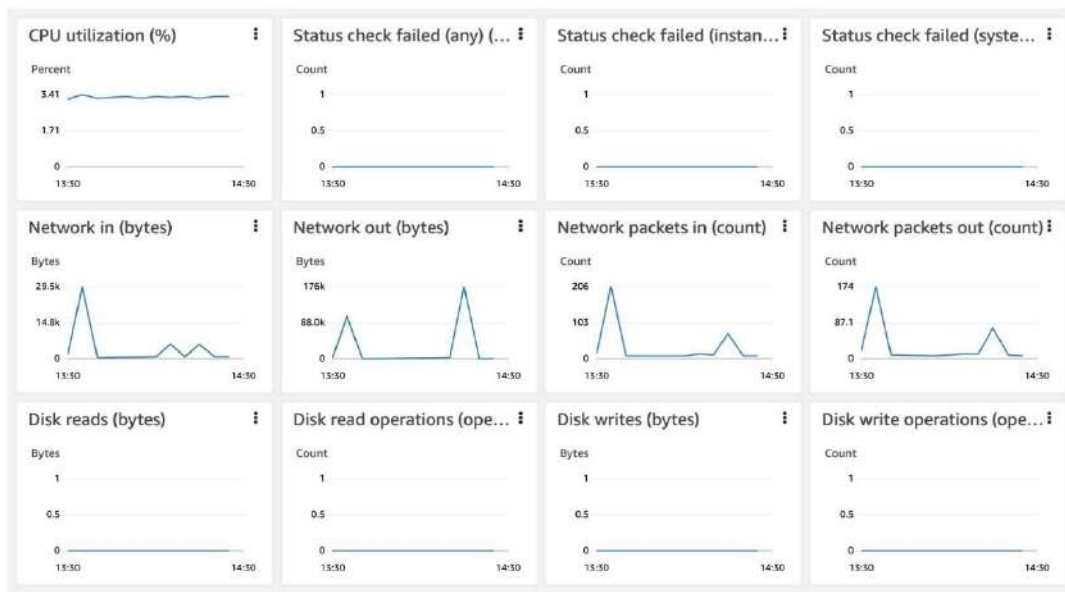


Figure 26: Server Performance

Additionally, we implemented a task offloading mechanism using Celery, a distributed task queue system, in conjunction with Django Python. This allowed us to delegate resource-intensive tasks to run on the backend asynchronously. Instead of executing these tasks immediately upon request, we stored them in a task queue and processed them in the background when server resources were available. By doing so, we ensured that our server's limited memory was utilized effectively for serving user requests, while resource-intensive tasks were handled separately without impacting the overall performance.

```
----- celery@Talha-Khalid.local v5.2.7 (dawn-chorus)
--- ***** ---
-- ***** --- macOS-11.7-x86_64-i386-64bit 2023-05-08 18:48:21
- *** --- * ---
- ** ----- [config]
- ** ----- .> app:         grepbing:0x1110d3220
- ** ----- .> transport:  redis://localhost:6379//
- ** ----- .> results:   redis://localhost:6379/0
- *** --- * --- .> concurrency: 4 (prefork)
-- ***** --- .> task events: OFF (enable -E to monitor tasks in this worker)
--- ***** ---
----- [queues]
      .> celery           exchange=celery(direct) key=celery

[tasks]
  . accounts.utils.sendmail
  . courses.recommender.collaborative_recommend
  . courses.recommender.content_recommend

[2023-05-08 18:48:22,086: INFO/MainProcess] Connected to redis://localhost:6379//
[2023-05-08 18:48:22,091: INFO/MainProcess] mingle: searching for neighbors
[2023-05-08 18:48:23,105: INFO/MainProcess] mingle: all alone
```

Figure 27: Background Tasks using Celery

To maximize efficiency on our limited server memory, we deployed our website on an AWS EC2 instance of the free tier t2.micro. This choice allowed us to take advantage of AWS's reliable and scalable infrastructure while effectively managing our memory constraints.

```
Welcome to Ubuntu 22.04.2 LTS (GNU/Linux 5.19.0-1024-aws x86_64)

* Documentation:  https://help.ubuntu.com
* Management:    https://landscape.canonical.com
* Support:       https://ubuntu.com/advantage

System information as of Sun May 14 14:35:31 UTC 2023

System load:  0.080078125      Processes:           110
Usage of /:   21.3% of 28.89GB  Users logged in:    0
Memory usage: 74%              IPv4 address for eth0: 172.31.4.174
Swap usage:   0%

* Ubuntu Pro delivers the most comprehensive open source security and
  compliance features.

  https://ubuntu.com/aws/pro

* Introducing Expanded Security Maintenance for Applications.
  Receive updates to over 25,000 software packages with your
  Ubuntu Pro subscription. Free for personal use.

  https://ubuntu.com/aws/pro

Expanded Security Maintenance for Applications is not enabled.

26 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

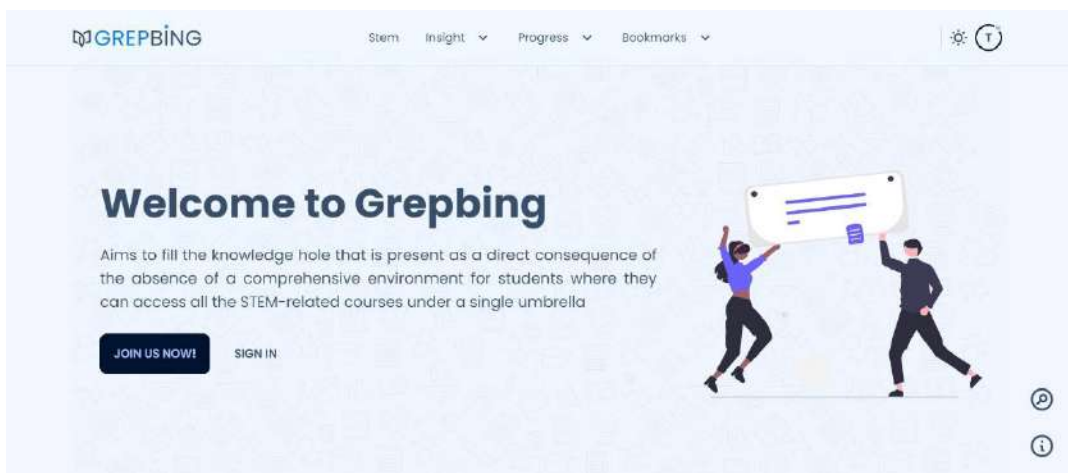
Last login: Sun May 14 12:28:08 2023 from 111.68.97.202
[ubuntu@ip-172-31-4-174:~$ ls
KnowledgegePedia  env  media  nltk_data  restart.sh  static
ubuntu@ip-172-31-4-174:~$ █
```

Figure 28: Successful Production Deployment

USER INTERFACES

In this section, we present the UI elements of Grepbing along with adequate description for each. The user interface serves as the primary means of interaction between the users and the software, enabling them to access and utilize the system's functionalities effectively.

9.1 Logged Out Views



UI Screenshot 1: Landing Page Intro



UI Screenshot 2: Landing Page Facts about Grepbing

Concept of the day

RECURSION

Definition

Recursion is the process in which a function calls itself again directly or indirectly.

Description

Recursion in programming is breaking down a problem into simpler versions of itself. For instance, if we want to write an algorithm "Find Lost Money", we would do so like this: if you found your money, stop looking. Take another step and look on the ground. "Find Lost Money". Here, we have broken down the problem into three simple steps. First, if you have found the money, you stop looking. Second, if you have not yet found the money, you take one more step and look on the ground. Finally, you redo the algorithm. In this way, we go back to step one. Here, the algorithm continues searching the ground until we have found the lost money. This is an example of tail recursion, where the very last statement is calling the recursive algorithm. A recursive algorithm has three main parts: Base case, that is the condition for when to stop. Progress towards base case. Recursive step, that is recalling the algorithm again. The base case is import..

UI Screenshot 3: Landing Page Concept of the Day

Let's Get In Touch

A contact form with four input fields: Name, Email, Subject, and Message. Below the fields is a dark blue button labeled "SEND MESSAGE".

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UI Screenshot 4: Landing Page Contact Form

GREPBING



SIGN IN

Email

Password

[Forgot password?](#)

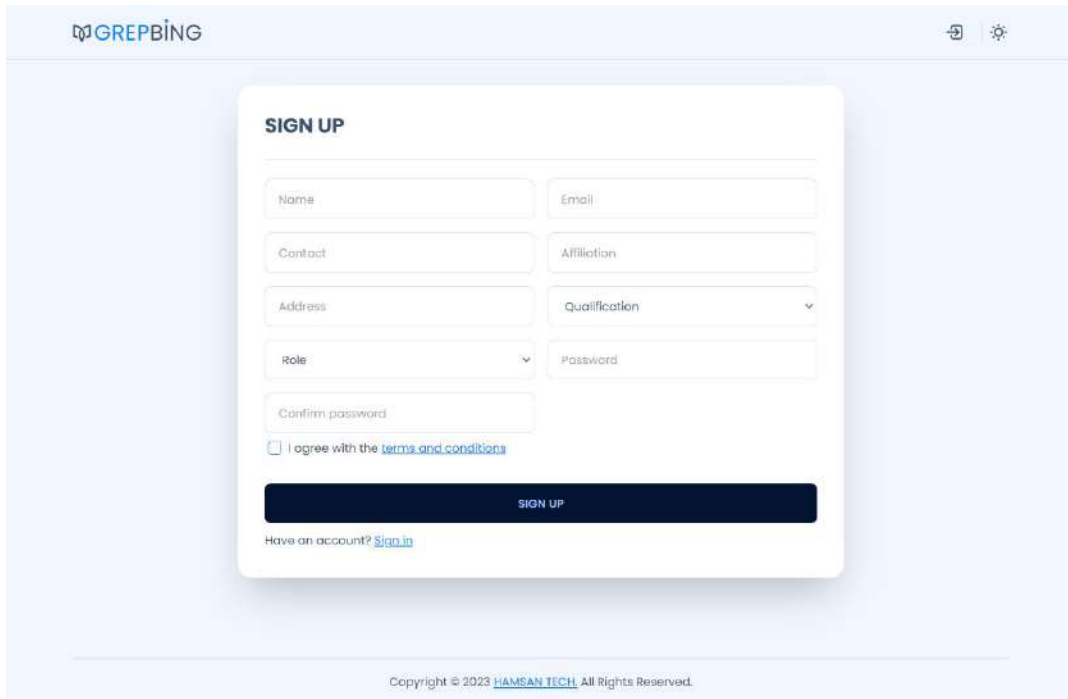
LOGIN

Don't have an account? [Sign up](#)

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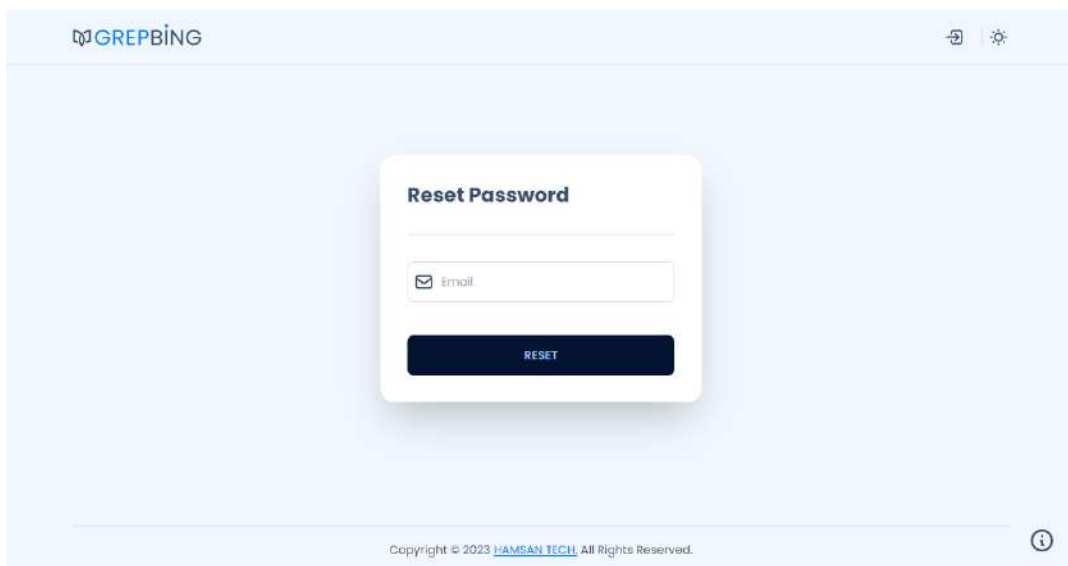


UI Screenshot 5: Sign In Form

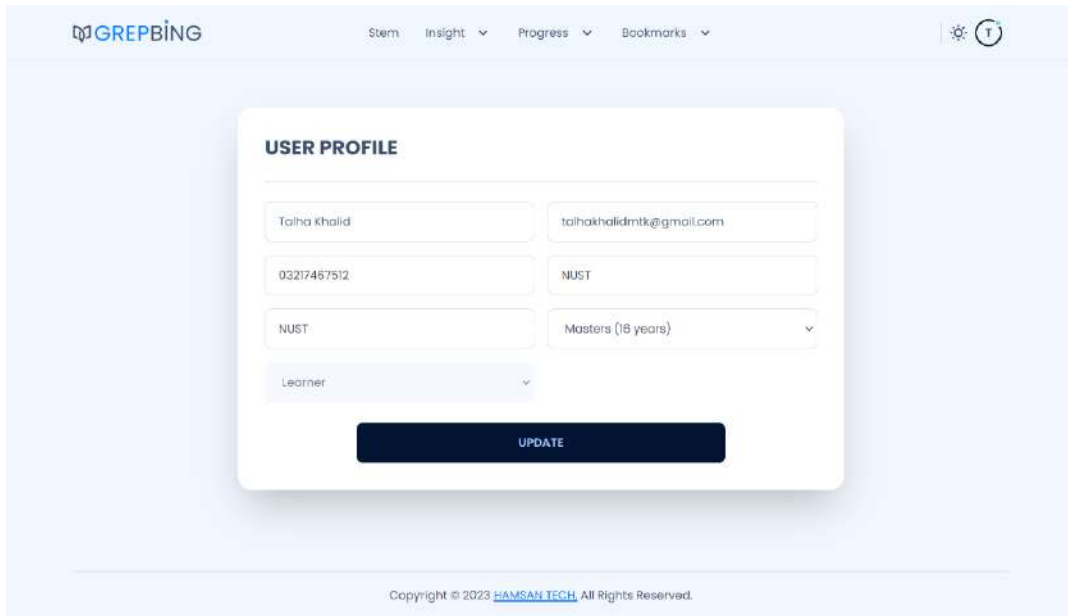


UI Screenshot 6: Sign Up Form

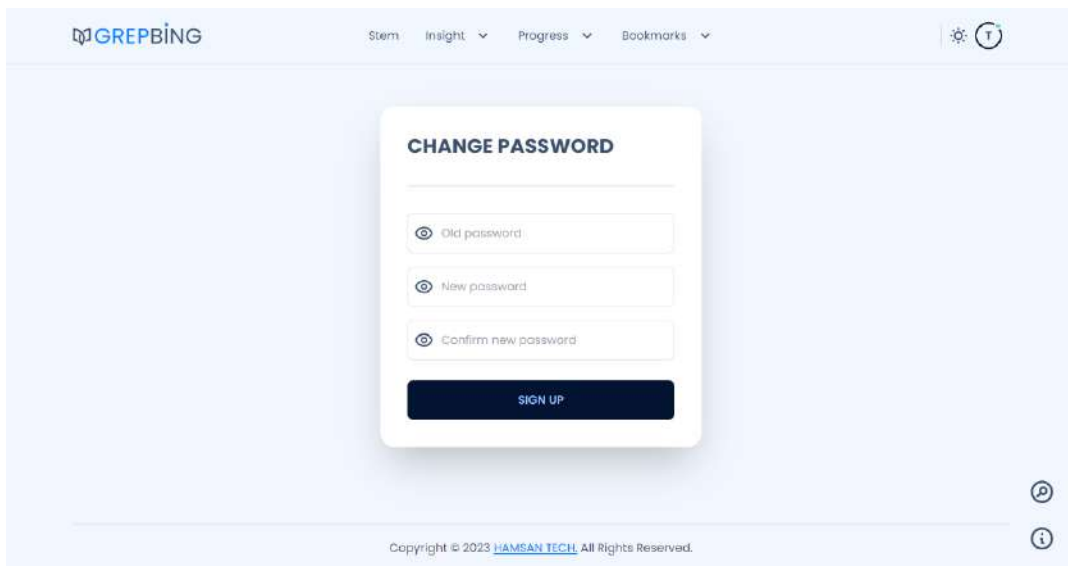
9.2 Learner Views



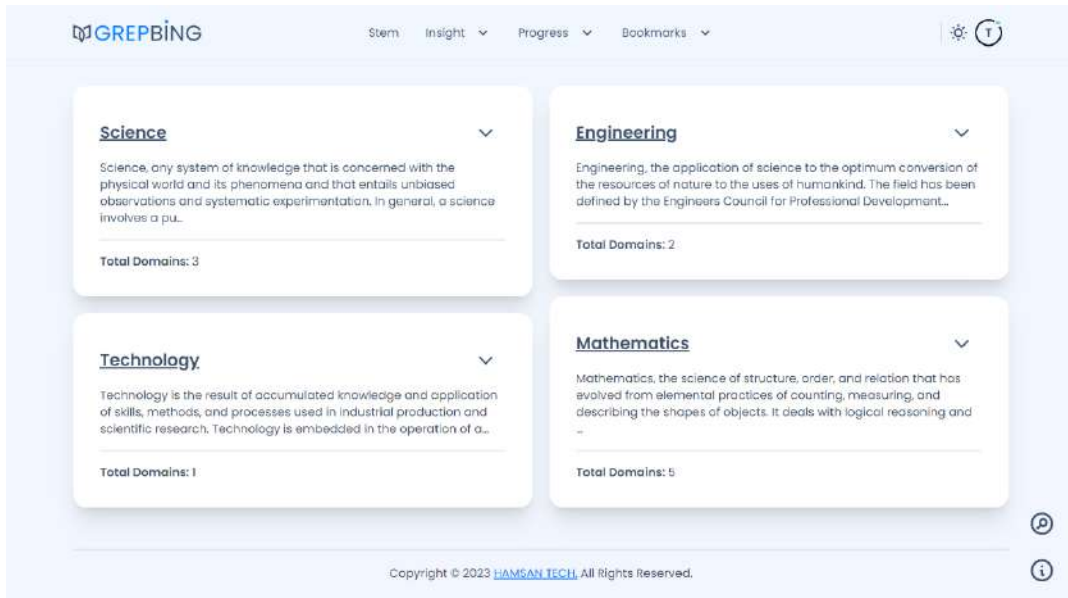
UI Screenshot 7: Reset Password Form



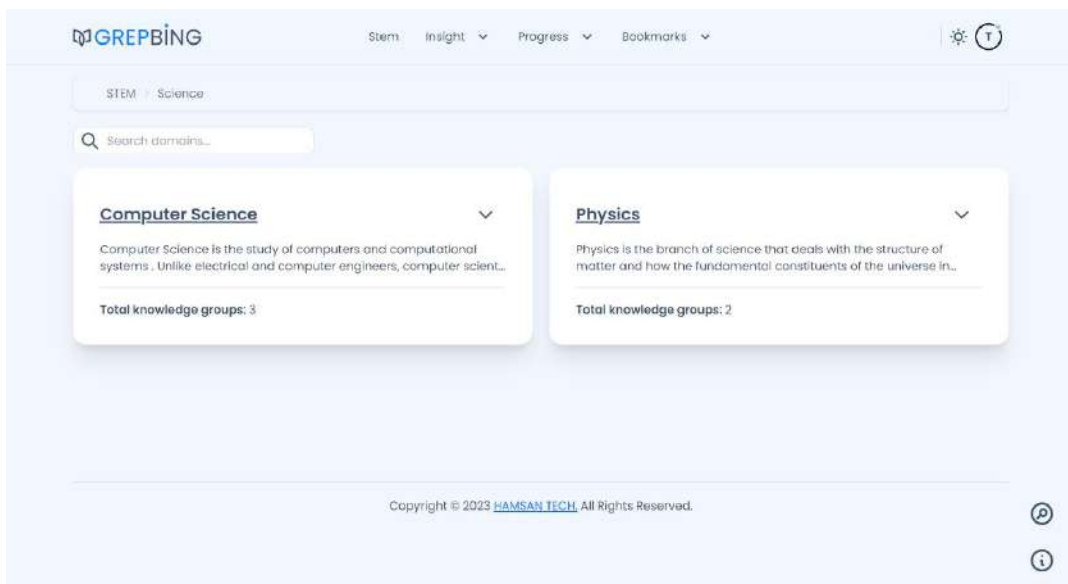
UI Screenshot 8: User Profile Form



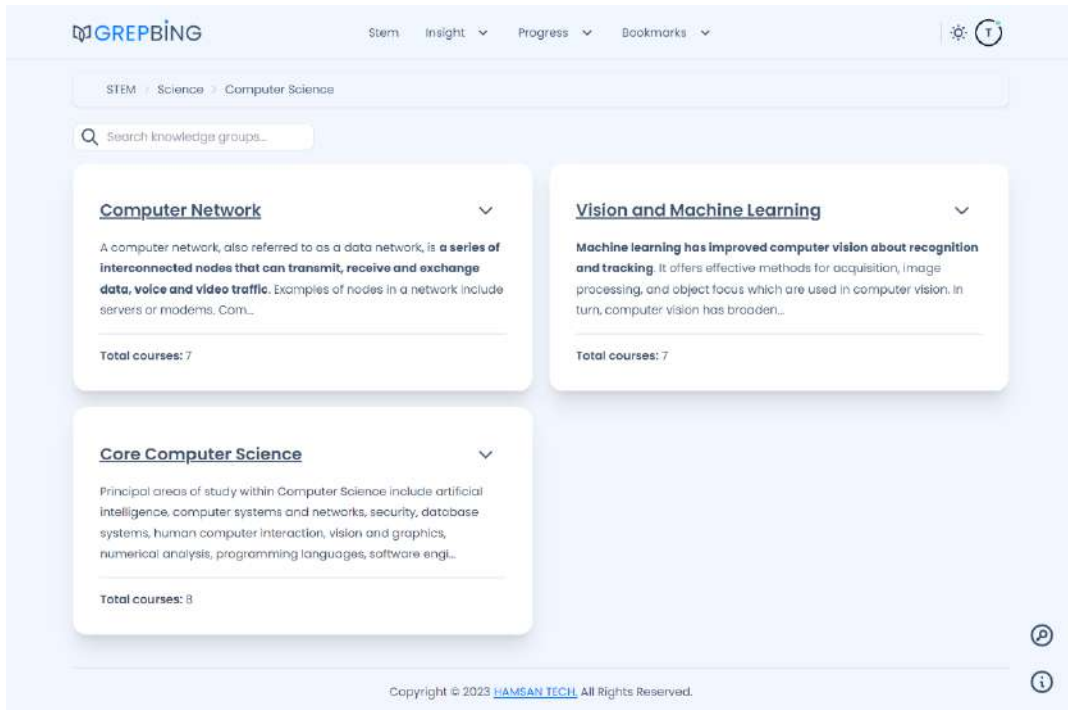
UI Screenshot 9: Change Password Form



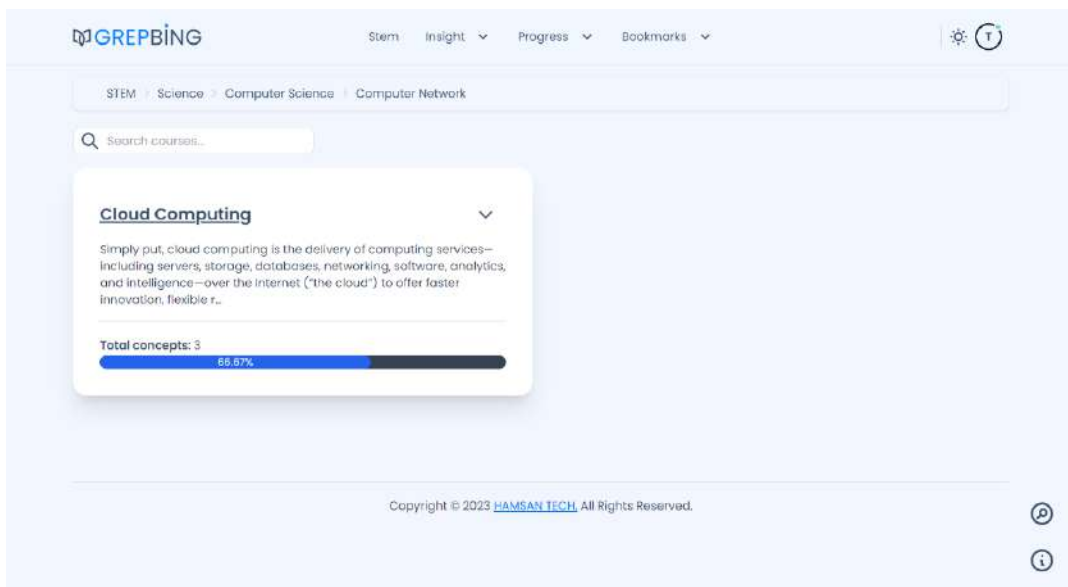
UI Screenshot 10: STEM View



UI Screenshot 11: Domain View



UI Screenshot 12: Knowledge Group View



UI Screenshot 13: Course View

GREPBING Stem Insight Progress Bookmarks

STEM > Science > Computer Science > Computer Network > Cloud Computing

Search concepts...

Docker os-level virtualization service products containerization docker engine

Pre-requisite: [Virtual Machine](#) Next concept: [Hypervisor](#)

Approved by: [Saeeda Sultana Sadia](#) Contributor: [Atiq Din](#)

Last visited: May 14, 2023, 8:34 A.M. GMT Avg. time spent: 3.91 Minutes

STATUS: PASS

Hypervisor third software level oracle vm virtualbox independent programs

Pre-requisite: [Virtual Machine](#), [Docker](#), [Containerization](#)

Approved by: [Saeeda Sultana Sadia](#) Contributor: [Sundus Sultana](#)

Last visited: Feb. 1, 2023, 4:26 P.M. GMT Avg. time spent: 2.61 Minutes

STATUS: FAIL

Virtual Machine operating system compute resource computer architectures

Next concept: [Hypervisor](#), [Docker](#), [Containerization](#)

Approved by: [Saeeda Sultana Sadia](#) Contributor: [Noor Ul Ain](#)

Last visited: Feb. 1, 2023, 4:26 P.M. GMT Avg. time spent: 2.34 Minutes

STATUS: PASS

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UI Screenshot 14: Concepts View

Time spent: 00 : 09 : 03

Status: Approved

★★★★★

Average: 3.87

You Rated: Not rated

Pre-requisite: [Virtual Machine](#)

Next concept: [Hypervisor](#)

Approved By: [Saeeda Sultana Sodki](#)

Contributor: [Atiqo Din](#)

View count: 133

Last visited: May 14, 2023, 8:34 A.M. GMT

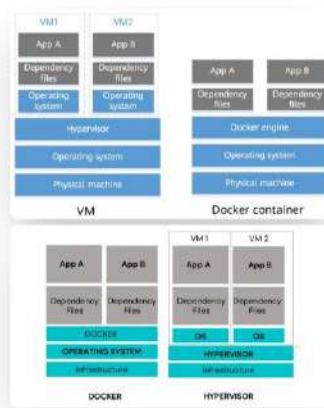
Avg. time spent: 3.91 Minutes

Quiz attempts: 13

Definition:

Docker is a set of platform as a service products that uses OS-level virtualization to deliver software in packages called containers. OS-Level virtualization is a technology that involves tailoring (a process by which an installation selects its operating system) a standard operating system to run applications handled by multiple users in one computer at the same time.

Diagram:



UI Screenshot 15: Concept Stats, Definition and Diagram

Description:

What is Docker?

Hykes started the Docker project in France. Docker was released as open-source in March 2013. Docker is an application build and deployment tool. It is free for Windows. It is based on the idea that you can wrap your code with dependencies into a deployable (act of moving to a place where they can be used when they are needed) unit called a container.

One of the main reasons companies use Docker is because they are more lightweight in terms of resources than virtual machines and they simplify the process of running applications.

Docker is used in DevOps, IT services, and software.

What are containers?

A container is a standard unit of software that wraps up your entire code and all its dependencies including the Operating system, application code, and system libraries. So, the application runs quickly from one environment to another.

They don't need their Operating System which frees up system resources.

Docker Modules

Docker compose: It allows you to run multi-container applications. With the Docker compose, a YAML file is used to arrange your containers.

Docker Machine: It allows you to deploy (an act of moving to a place where some action can be performed) containers to a cloud (servers that run over the internet).

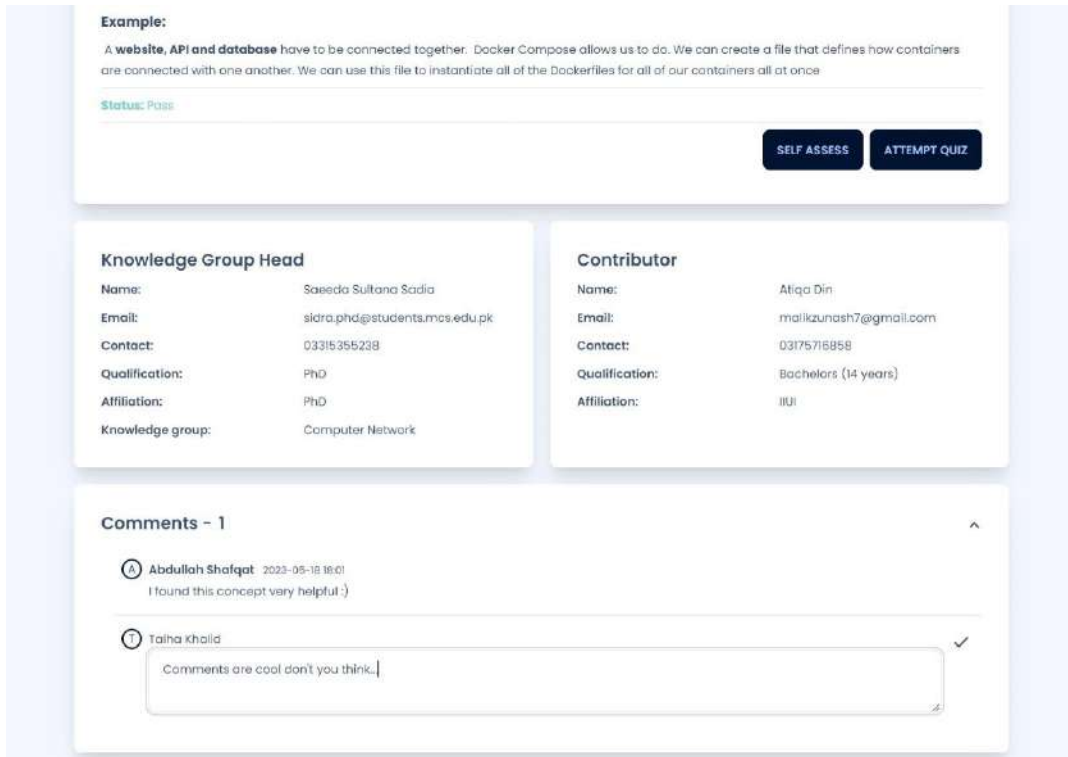
Docker Stack: It allows you to manage containers with Docker swarm (manage containers across different host machines).

Components of Docker

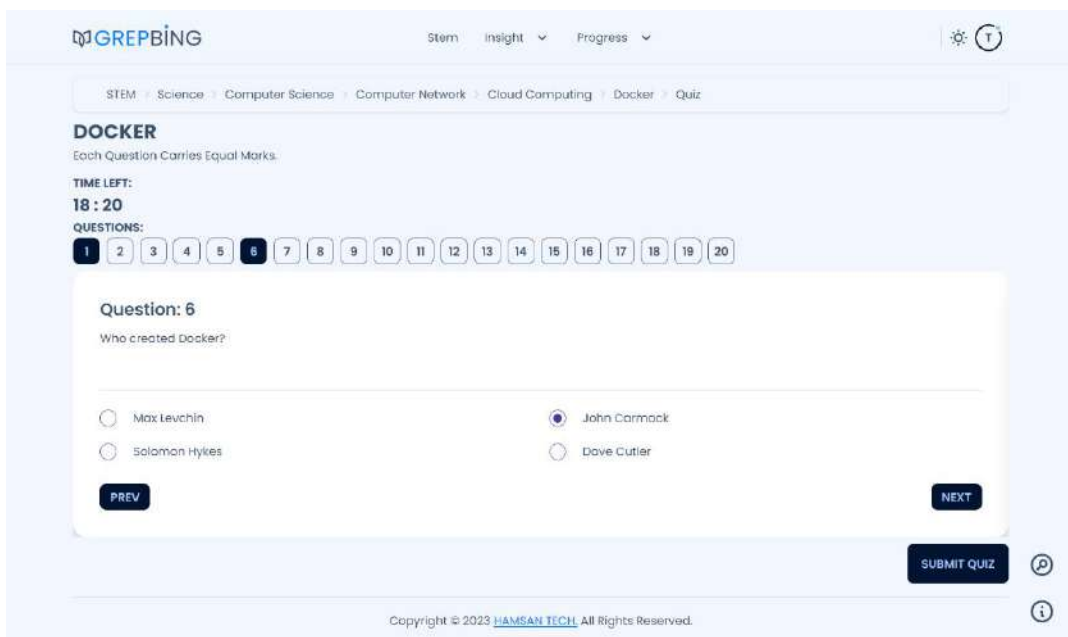
There are four components of Docker:

- Client-server
- Docker Image
- Docker Container
- Docker Registry

UI Screenshot 16: Concept Description



UI Screenshot 17: Concept Example, CTA Buttons and Comments



UI Screenshot 18: Concept Quiz Attempt

STEM > Engineering > Software Engineering > Programming Language > Data Structures and Algorithms > Arrays > Short Q&As

ARRAYS

Answer each question to the best of your ability

Question 1

What are the two types of arrays mentioned in the text?

The two types of arrays mentioned in the text are
 one dimensional arrays
 multi dimensional arrays

Grade: 7/10

Remarks: The answer is correct and identifies the two types of arrays mentioned in the text.
Better Answer: One dimensional arrays and multi-dimensional arrays are the two types of arrays discussed in the given source material, with examples and initialization methods provided for each type. However, the answer could be improved by providing more specific details or examples.

UI Screenshot 19: Concept Short Question Answer Attempt

GREPBING

Stem Insight Progress Bookmarks

Talha Khalid's Grades

Search Here...

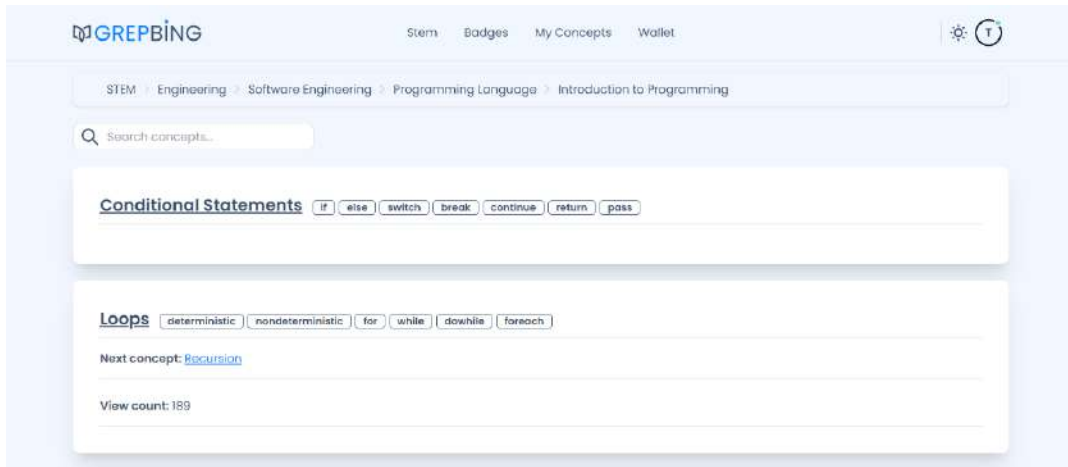
#	CONCEPT	COURSE	OBTAINED MARKS	TOTAL MARKS	DATE	STATUS
1	Virtual Machine	Cloud Computing	0.0	20	14-May-2023	FAIL
2	Docker	Cloud Computing	0.0	20	09-May-2023	FAIL
3	Hypervisor	Cloud Computing	1.0	20	07-May-2023	FAIL
4	Hypervisor	Cloud Computing	1.0	20	07-May-2023	FAIL
5	Queues	Data Structures and Algorithms	3.0	20	07-May-2023	FAIL
6	Virtual Machine	Cloud Computing	1.0	20	06-May-2023	FAIL
7	Docker	Cloud Computing	0.0	20	06-May-2023	FAIL
8	Induction	Formal Methods	3.0	20	06-May-2023	FAIL
9	Hypervisor	Cloud Computing	7.0	20	05-May-2023	FAIL
10	Recursion	Introduction to Programming	1.0	20	02-May-2023	FAIL

PREVIOUS 1 2 3 NEXT

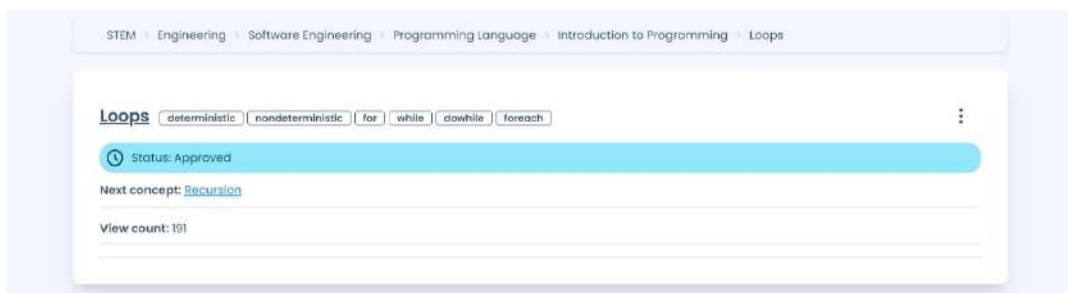
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UI Screenshot 20: Learner's Grades

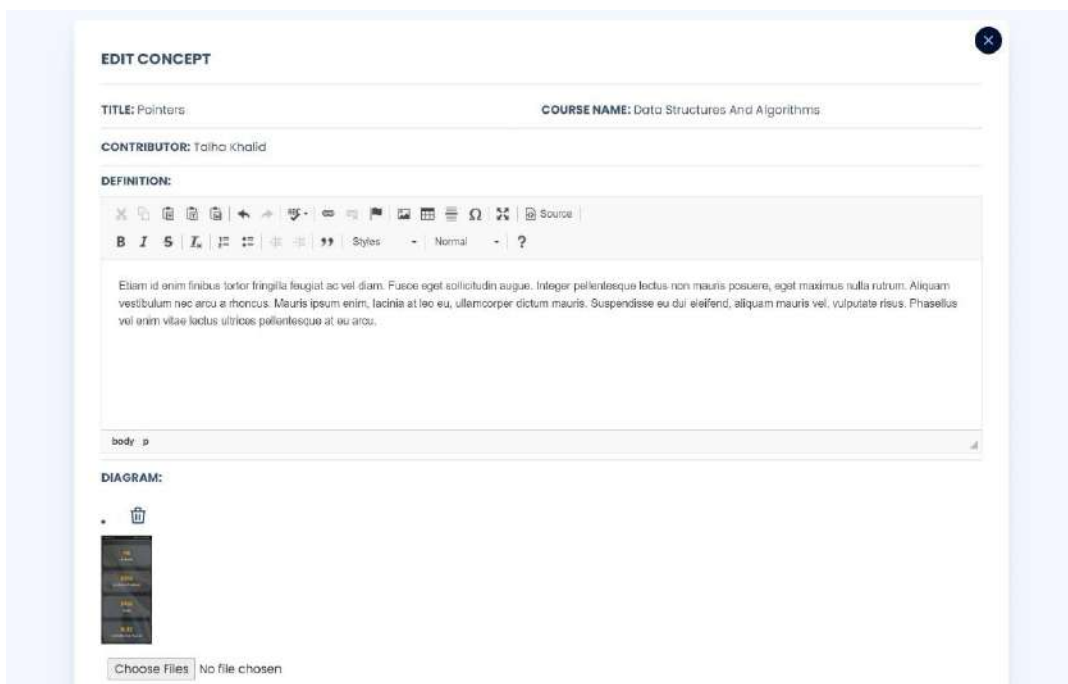
9.3 Contributor Views



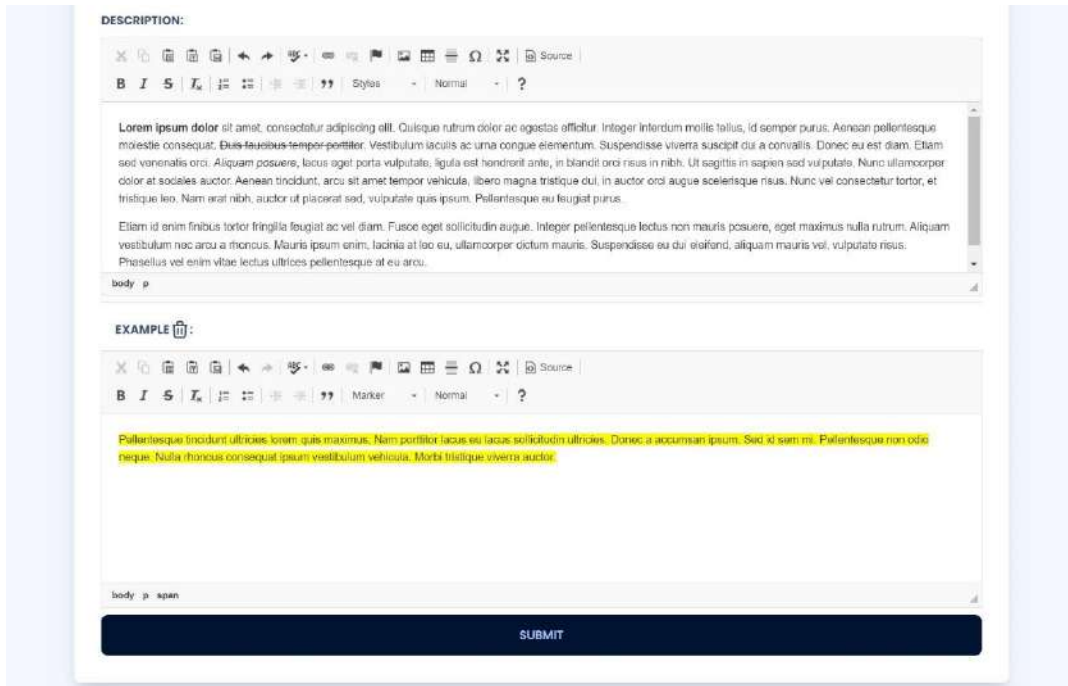
UI Screenshot 21: Contributor Concepts



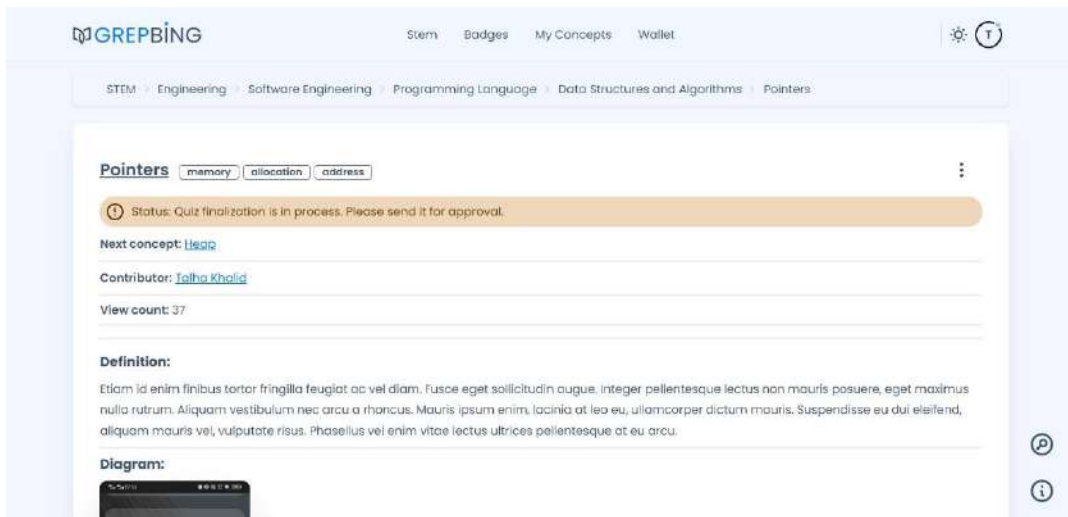
UI Screenshot 22: Approved Contributor Concept



UI Screenshot 23: Edit Concept Definition and Diagram



UI Screenshot 24: Edit Concept Description and Example



UI Screenshot 25: Under Process Contributor Concept

GREPBING Stem Badges My Concepts Wallet ⚙️ 🕒

STEM / Engineering / Software Engineering / Programming Language / Data Structures and Algorithms / Pointers / QUIZ

ADD QUESTION

POINTERS QUIZ

Pointers Quiz Description

Time limit:	10 minutes
Total Questions:	3
Total Marks:	3

Question: 1 ✎ 🗑️

Marks: 1

Pointers in programming are used to store the actual value of a variable.

True **False**

Question: 2 ✎ 🗑️

Marks: 1

What does a pointer variable store?

The actual value of the variable **The memory address of a variable** The size of the variable The data type of the variable

Question: 3 ✎ 🗑️

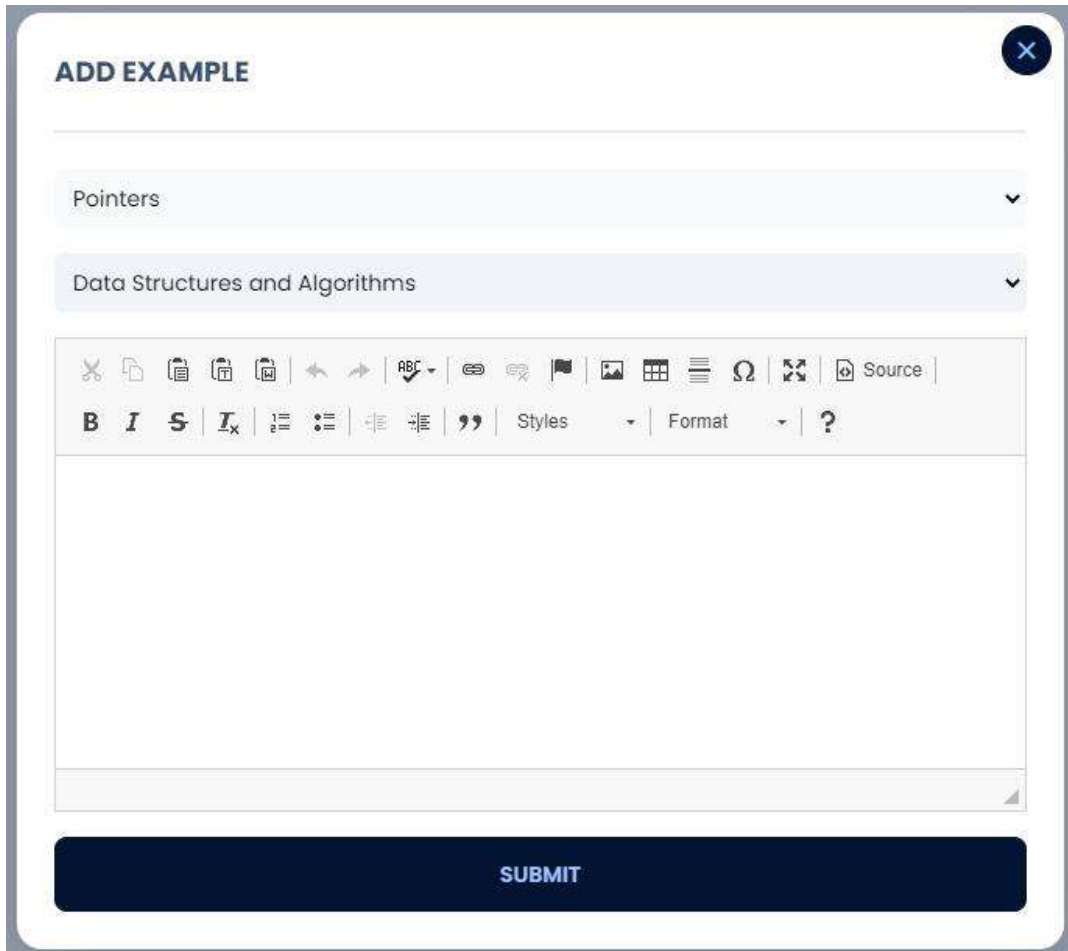
Marks: 1

In programming, a pointer is a variable that stores the [blank] of another variable.

memory address

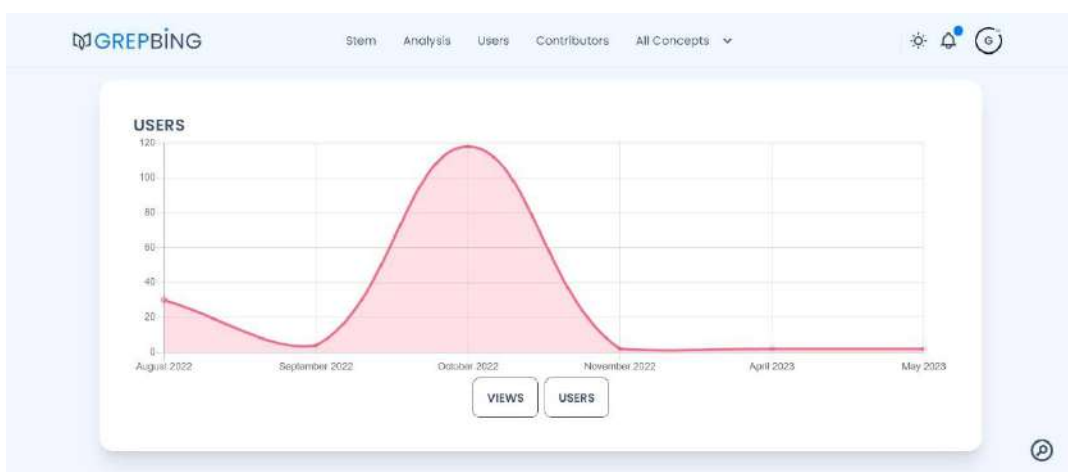
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UI Screenshot 28: Contributor Quiz Creation Preview



UI Screenshot 29: Adding Example to Concept

9.4 Admin Views



UI Screenshot 30: Userbase Graph



UI Screenshot 31: Admin Site Stats

GREPBING | Stem | Analysis | Users | Contributors | All Concepts

Science

Science, any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation. In general, a science involves a pu...

Engineering

Engineering, the application of science to the optimum conversion of the resources of nature to the uses of humankind. The field has been defined by the Engineers Council for Professional Development, in the United States, as the creative application of "scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behaviour under specific operating conditions, all as respects an intended function, economics of operation and safety to life and property." The term engineering is sometimes more loosely defined, especially in Great Britain, as the manufacture or assembly of engines, machine tools, and machine parts.

Technology

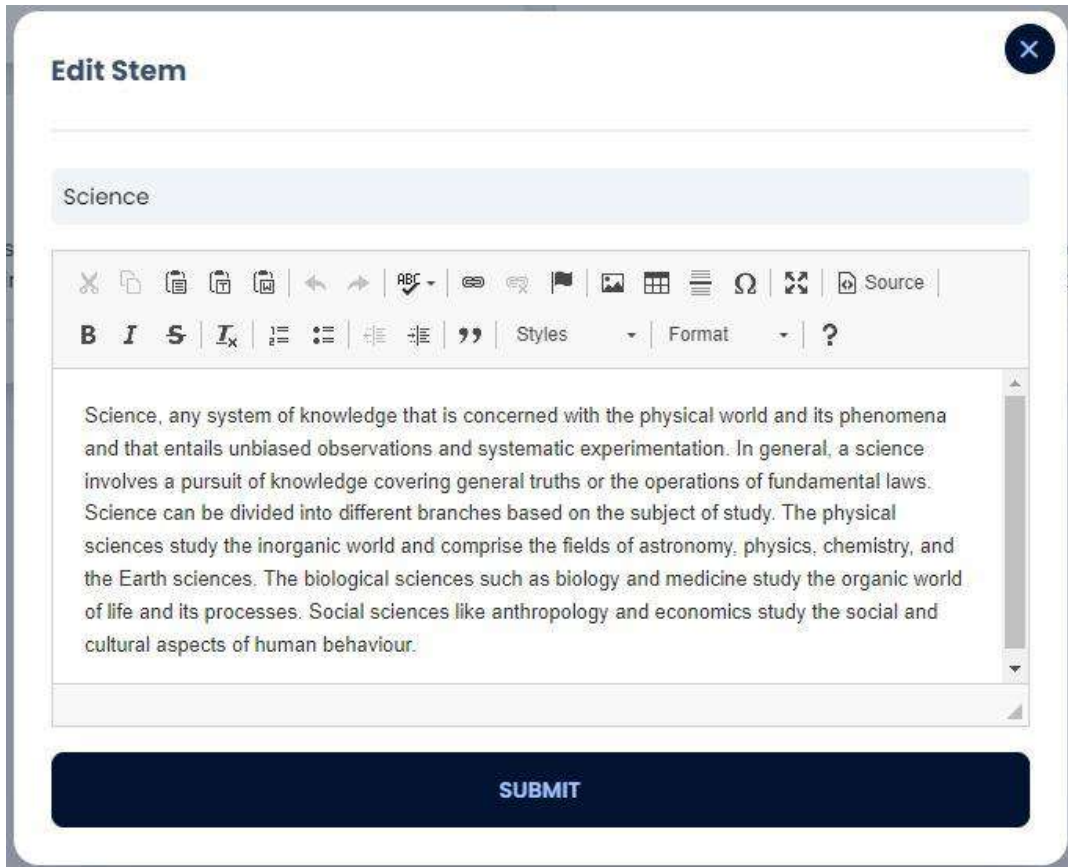
Technology is the result of accumulated knowledge and application of skills, methods, and processes used in industrial production and scientific research. Technology is embedded in the operation of all machines and electronic devices, with or without detailed knowledge of their function, for the intended purpose of an organization. The technologies of society consist of what is known as systems. Systems operate by obtaining an input, altering this input through what is known as a process, and then producing an outcome that achieves the intended purpose of the system.

Mathematics

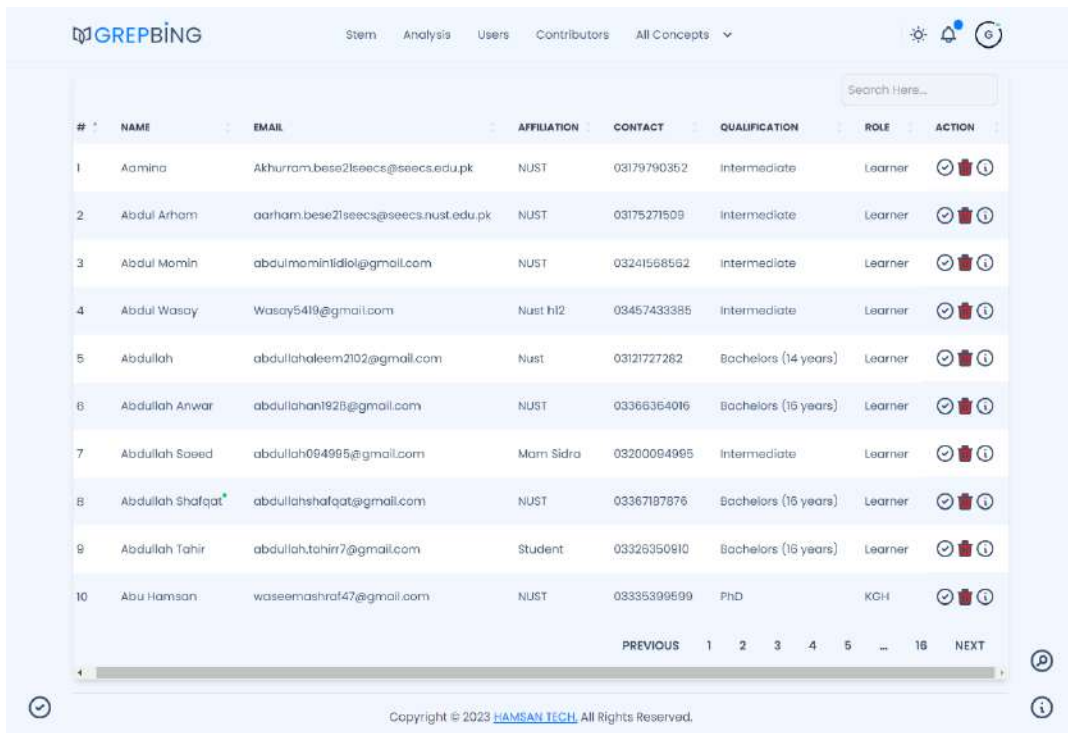
Mathematics, the science of structure, order, and relation that has evolved from elemental practices of counting, measuring, and describing the shapes of objects. It deals with logical reasoning and

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UI Screenshot 32: Admin STEM View with Edit Action



UI Screenshot 33: Editing STEM Details



UI Screenshot 34: Admin All Users View with Approve, Delete and Information Actions

Abdullah Shafqat's Details

Date Joined: May 14, 2023, 12:17 p.m. (GMT) Last Login: May 15, 2023, 6:34 p.m. (GMT)

Contributor's Profile

#	CONCEPT	COURSE	KNOWLEDGE GROUP	DOMAIN
No data available in table				

PREVIOUS NEXT

Learner's Profile

#	CONCEPT	OBTAINED MARKS	TOTAL MARKS	DATE	STATUS
-	Separation of Concerns	4.0	21	14-May-2023	FAIL

PREVIOUS 1 NEXT

You can always contact us @ info@grepbing.com

UI Screenshot 35: Admin User Details View

GREPBING Stem Analysis Users Contributors All Concepts

Settings Notifications Profile

Search Here...

#	NAME	EMAIL	CONTACT	BALANCE	APP.	PEND.	IN PROC.	REJ.	ACTION
1.	Noor ul Ain	noor72472@gmail.com	03338469103	3000.0	6	0	2	0	
2.	Atiqa Din	malikzunash7@gmail.com	03175718658	1500.0	2	0	2	0	
3.	Sundus Sultana	sundussultanass@gmail.com	03319620815	1500.0	3	0	2	0	
4.	Izzah Aslam	iaslam.besa2lseecs@seecs.edu.pk	03026042995	1000.0	1	0	0	0	
5.	Faizyab Ali Shah	fshah.bcs2lseecs@seecs.edu.pk	03149853997	500.0	1	0	0	0	
6.	Mahad Rahat	mahadrahat2@gmail.com	03338922231	500.0	1	0	0	0	
7.	SEHAR FATIMA	doll89497@gmail.com	03358733237	500.0	1	1	0	0	
8.	Hina Naeem	hinanaeem426@gmail.com	03131776717	500.0	3	0	1	0	
9.	Navaira Rehman	nrehman.besa2lseecs@seecs.edu.pk	03211077923	500.0	1	0	0	0	
10.	Talha Khalid	talhokhalidmtk@gmail.com	03217487512	0.0	0	0	1	0	

PREVIOUS 1 2 3 NEXT

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UI Screenshot 36: Admin All Contributors View with Information and Payout Actions

Noor ul Ain's Details ✕

Bank Details

Account Number	03338469103
Account Holder Name	Noor ul Ain
Bank Name	Easypaisa

Concept Details

Approved Concepts:
Inheritance, K-mean Clustering, Separation of Concerns, Arrays, Change Anticipation, Virtual Machine

Pending Concepts:

In Process Concepts:
Aggregation, Polymorphism

Rejected Concepts:

You can always contact us @ info@grepbing.com

UI Screenshot 37: Admin Contributor Details View

CONCLUSION AND FUTURE WORK

In this final section, we present the conclusion and future work of the Grepbing project, summarizing the achievements and contributions made during its development and outlining potential areas for further enhancement and expansion.

10.1 Conclusion

The development of the Grepbing has been a significant achievement, fulfilling all the proposed functional and non-functional requirements stated in the SRS document. We have successfully designed a user-friendly platform that addresses the specific needs of learners, offering a comprehensive hub of knowledge for individuals at any stage of learning. By minimizing the drawbacks of existing e-learning platforms, Grepbing aims to provide a seamless and enriching learning experience.

10.2 Future Work

While we celebrate our progress and accomplishments, there are still areas that require further attention and improvement. In the future, we intend to expand the functionalities of Grepbing to enhance the learning experience and cater to the evolving needs of our users. Some potential areas of future work include:

1. **Continuous Content Expansion:** Foster the growth of the platform by encouraging contributions from users and experts, ensuring that the catalog of concepts remains up to date and comprehensive. Implement a robust review system that maintains a preset criterion to guarantee the quality and relevance of the added content, including concepts, quizzes, and diagrams.
2. **Enhanced Assessment Features:** Develop advanced assessment features, including personalized quizzes, interactive simulations, and practical

exercises, to provide learners with a more immersive and engaging learning experience. These features will enable users to apply their knowledge and receive immediate feedback, reinforcing their understanding of the subject matter.

3. **Social Learning Community:** Create a social learning community within Grepbing, allowing users to connect, collaborate, and share knowledge. Incorporate discussion forums, chat rooms, and user profiles to facilitate interaction and foster a sense of belonging among learners.

By prioritizing these future developments, we aim to solidify Grepbing's position as a leading e-learning platform, revolutionizing the way knowledge is acquired and shared. Through continuous improvement and adaptation, we strive to empower learners and contribute to the growth of a knowledgeable and skilled society.

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