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Question bank Management

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Question Bank Management

Abstract

The aim of this project is to organize and ease the process of question bank management through a web-based application. Question Bank Management can mainly be bifurcated into two important tasks viz. Question Creation and Question Reviewal.

The application simplifies the task of adding elements like diagram, equations and code to questions by providing interfaces for the same. For better discretion of solving the questions, elements like difficulty level, Category, tags and expected solving time can also be added to question.

The applicaton shall automate the task of evenly distributing the questions amongst the users. Revision history to keep track of all changes made to a question and control the versions of a question, is also maintained by this application.

The ultimate goal of this application is to reduce the fuss created in a closed group during the conventional question bank management process and give the process a drive(which the conventional process may lack) that is required for efficient and harmonious performance of the outfit.

Completion status

- Task Accomplished
    1. Freezing the SRS (Software Requirements Specification)
    2. Set up and study Laravel and Database Management
    3. Schema Development
    4. Documentation
- Added the following features :
    1. Account management (including access management)
    2. Revision History of Question
    3. Ability to add Difficulty level of questions and expected solving time
    4. Converting question text to image
    5. Adding diagrams to questions
    6. Adding questions with choices
    7. Equation box (latex to image)
    8. Coding window (code text to image)
    9. Adding difficulty level tags and category tags
    10. Navigating Questions

1.1 Hardware parts

- No Hardware parts used

1.2 Software used

1. Linux environment

   - Setting up the system:
     (a) Software Used: Ubuntu
     (b) Software version: 16.04
     (c) download link
   - Setting up the server
     (a) Software used :
       – Apache
       – PHP
     (b) Versions:
       – Apache 2.4.12
       – PHP 5.6.11
     (c) Installation:
       – Apache

         ```
         sudo apt-get install apache2 libapache2-mod-php
         ```

       – PHP

         ```
         sudo add-apt-respository ppa:ondrej/php5
         sudo apt-get update
         sudo apt-get install php5 php5-mcrypt php5-gd
         sudo php5enmod mcrypt
         ```

   - Setting up the PHP framework
     (a) Software Used :
       – Composer
       – Laravel
     (b) Version:
       – Laravel 5.2.39
       – Composer 1.1.2
     (c) Installation:
       – Composer

         ```
         curl -sS https://getcomposer.org/installer | php
         sudo mv composer.phar /usr/local/bin/composer
         ```

       – Laravel

```
cd /var/www/html
sudo composer create-project laravel/laravel
your-project --prefer-dist
```

(d) Configuring Apache :

- Ensure that the project folder has proper permissions.

```
sudo chgrp -R www-data /var/www/html/project
sudo chmod -R 775 /var/www/html/project/storage
```

- Now go to the /etc/apache2/sites-available directory and use the following command to create a configuration file for our laravel install

```
cd /etc/apache2/sites-available
sudo nano laravel.conf
```

- Now add the following content to the file and close it after saving.

```
<VirtualHost *:80>
    ServerName localhost

    ServerAdmin webmaster@localhost
    DocumentRoot /var/www/html/project/public

    <Directory /var/www/html/project>
        AllowOverride All
    </Directory>

    ErrorLog ${APACHE_LOG_DIR}/error.log
    CustomLog ${APACHE_LOG_DIR}/access.log combined
</VirtualHost>
```

2. Revisionable Trait

- Revisionable Trait named sofaRevisionable Trait is used
- Refer the link to import the revisionable trait.
- According to the need, the Revisionabletrait.php file in Revisionable trait was modified and used.

1.3 Assembly of hardware

No Hardware has been used

1.4 Software and Code

Github link

1.4.1 Database Schema

The database schema used in the application has been described in detail in the following sections

1. *equations(exp_id,exp_latex,exp_image,created_at,updated_at)*
   - exp_id : auto-incrementing primary key
   - exp_latex : expression of the equation in LaTeX
   - exp_image : link to the image stored in the file-system
   - created_at : timestamp of creation
   - updated_at : timestamp of updation
2. *codes(code_id, code_description, code_image_path, created_at, updated_at)*
   - code_id : auto-incrementing primary key
   - code_description : description of code
   - code_image_path : link to the image stored in the file-system
   - created_at : timestamp of creation
   - updated_at : timestamp of updation
3. *diagram(diagram_id, path, created_at, updated_at)*
   - diagram_id : auto-incrementing primary key
   - path : link to the diagram stored in the file-system
   - created_at : timestamp of creation
   - updated_at : timestamp of updation
4. *category(key, name, created_at, updated_at)*
   - key : auto-incrementing primary key

- name : name of the category(Quantitative, Programming or Electronics)
- created_at : timestamp of creation
- updated_at : timestamp of updation

5. *difficulty(key, name, created_at, updated_at)*

   - key : auto-incrementing primary key
   - name : difficulty name(Easy, Medium or Hard)
   - created_at : timestamp of creation
   - updated_at : timestamp of updation

6. *maths_symbols(id, code, description, type, created_at, updated_at)*

   - id : auto-incrementing primary key
   - code : HTML UTF-8 code of the mathematical symbols
   - description : short description of the symbol
   - type : used to point to the subject matter where the symbol is commonly used in
   - created_at : timestamp of creation
   - updated_at : timestamp of updation

   The data stored in this table has not been entered manually. A Map-Reduce process using Hadoop was implemented to process the data present on the web-page of w3schools.com(link here) and filter it into a form conforming with structure of the table implemented. JAR file of the program used is in the project folder titled *MathSymbolsProcessor.jar*.

7. *math_symbols_group(id, group_name, div_id, created_at, updated_at)*

   - id : auto-incrementing primary key
   - group_name : Name of the topic pertaining to which special symbols have been stored
   - div_id : used in assigning IDs to divisions created in views
   - created_at : timestamp of creation
   - updated_at : timestamp of updation

8. *options(option_id, q_id, revision, option_no, description, created_at, updated_at)*
    - option_id : auto-incrementing primary key
    - q_id : key of the question whose options are being stored
    - revision : the version of the options (changed when the options are changed)
    - option_no : the serial number of the option in the list of options
    - description : Content of each option
    - created_at : timestamp of creation
    - updated_at : timestamp of updation
9. *tags(id, name, created_at, updated_at)*
    - id : auto-incrementing primary key
    - name : name of the tag with unique constraint
    - created_at : timestamp of creation
    - updated_at : timestamp of updation
10. *q_tag_relations(key, q_id, tag_revision, tag_id, created_at, updated_at)*
    - key : auto-incrementing primary key
    - q_id : key of the question whose tags are being stored
    - tag_revision : the version of the tags (changed when the tags are changed)
    - tag_id : ID of the tag whose nam is stored in *tags* table
    - created_at : timestamp of creation
    - updated_at : timestamp of updation
11. *q_tables(q_id, description_id, exp_id, created_by, last_edited_by, diagram_id,current_revision, options, code_id, difficulty, time, category, tag_revision, created_at, updated_at)*
    - q_id : auto-incrementing primary key to identify each question in the database uniquely
    - description_id : contains a reference to a record in descriptions table which has the description details of the question

- exp_id : contains a reference to a record in the equations table which stores all the details pertaining to the created equations
- created_by : contains a reference to a user in the users table who has created that particular question
- last_edited_by : contains a reference to a user in the users table who has most recently made any changes to the question(be it review or edit)
- diagram_id : contains a reference to diagrams table where details of the diagram stored in the file system are stored
- current_revision : stores the current version of the question
- options : stores the current version of options being used
- code_id : Stores a reference to a record in the codes table where details regarding the code being used in the questions is stored
- difficulty : stores the difficulty level of question
- time : stores the time required to solve a particular question
- category : category of each question(Quantitative, Electronics or aptitude)
- tag_revision : the current version of the tags (changed when the tags are changed)
- created_at : timestamp of creation
- updated_at : timestamp of updation

1.4.2 Features

1. User Authentication and Registration

- The application supports 2 types of users :
  (a) Administrator
  (b) Normal User
- The Application houses and serves a closed group of users, due to which common users are unable to register onto the application.
- The Admin has the authority to add new users to the application
- The admin can also delete users if needed.
- A user wont be able to access any of the utilities of the application unless she/he has been authenticated or unless she/he has a user account registered for him

- Normal users may further have two roles creator(user who creates the question) and reviewer(who reviews questions allotted to him).

2. Question Creation

- Question description and Coding box :
  - Question description being typed by the user is transformed into image in real-time and previewed below accordingly.
  - The description being typed is entered on an HTML hidden canvas which is then used to generate an image, whose URL is updated in the image present on every *'onkeyup'* event
  - The same coding logic applies for the code to image conversion, only with variation in colors and text font used to give look and feel consistent with the field of coding
- Equation Box :
  - The LaTeXcode for equation typed in this window is used to obtain the image URL generated of the equation photo generated by the open API of code-cogs. CodeCogs equation editor
  - The URL of the image generated is dependent on the equation typed.
  - The URL shall have a fixed part and an variable part which varies with every equation
  - This is the permanent part :

    ```
    https://latex.codecogs.com/gif.latex?
    ```

  - As said earlier the variable part is dependent on equation being typed which is obtained in the following manner:
    (a) if the number of adjoining spaces is more than one then they are replaced with just one single space using the following regular expression :

    ```
    "\s+"
    ```

    (b) then variable part is URI encoded and then concatenated to the fixed part which generates the entire link, which can now be updated in the *src* of the image preview tag and the value of the hidden form field
- Options :
  Options are being created on an *onkeyup* event on the number field specified. There can be 2-6 options currently

- Diagram:
  Users can upload the diagrams, from their local file-systems to add to the question.
- Tags and Category :
  - Each question must fall into either of the following categories pertaining to the subject matter
    (a) Quantitative
    (b) Electronics
    (c) Programming
  - Each question must have certain tags to it pertaining to the concepts of topics covered in the question
    eg: turing machine, integrtion, C etc
- Time Required and difficulty level of questions
  - For better discretion of solving the question bank creators must give attributes to questions like Time Required(minimum 30 seconds) and Difficulty level of questions (easy, medium or hard).
- Special symbols keyboard
  - Data stored in the tables maths_symbols and math_symbols_group about the symbols is used to render the keyboard.

3. Picking a Question

- While browsing the question bank the users may want to compose a new question by making minor changes to an existing question
- The users shall be redirected to page with the form similar to that of the Compose interface, with fields set to the value of the initial question.
- on submit the post request is sent to the Controller closure of the Create a question feature and a new question is composed with the creator set to the user who picked the question

4. Editing a Question
    - While browsing his own questions in the 'Home' the user may find that the content of any question he/she created is inconsistent with the subject matter
    - The user can then edit that question and correct it. For editing the user shall be directed to an interface similar to that of compose with fields set current attributes of the question.
    - After making the changes, the post request for that page shall be sent to controller closure where the received values from that form are compared with the existing values, if the values are the same, no updates are made.
5. Navigating the Question Bank
    (a) Currently searching the questions is based on tags and string search on the question description. Search box for entering the string and a multiple select box for the selecting the tags is provided. This feature has been implemented in the *Home* and *Browse* interface
    (b) *Home*
        - Here the User can browse the questions created by him
        - Search queries sent from here are give results of the questions created by that user, that satisfy the submitted queries
    (c) *Browse*
        - Here the User can browse the entire Question Bank
        - Search queries sent from here, give results of the questions that satisfy the submitted queries
6. Review
    (a) Criteria : For Distribution of questions to reviewers
        - Each question should have only 2 reviewers.
        - The Creator of the questions should not get his/her own created questions for reviewing.
        - The Distribution of questions should be on fairness and efficiency basis.
    (b) Process : Allotting questions to review

- The process runs a special algorithm to submit questions for review
- The algorithm distributes questions to the different users efficiently and in such a way that the user is paired with all the other users
- From the set of all possible pairs, random pairs is given a question to review individually
- The pair should not be repeated until all the combinations of pairs of different users are allotted a question
- Once the question is allotted, the flag of allotment is set which indicates the status whether 'allotted' or not
- After the question is reviewed, the flag of review is set which indicates whether reviewed or not.

(c) Algorithm :

- The list of users who created the question is fetched from the database.
- The list of questions that are to be reviewed is fetched from the database.
- A matrix is created where the $(i, j)^{th}$ element corresponds to the pair of i^{th} and j^{th} reviewer.
- The upper triangular portion of this matrix is used to enumerate all possible unique pairs where both the reviewers are different.
- A pair of reviewers is chosen for each question using round robin algorithm on enumerated pairs generated in step 4.

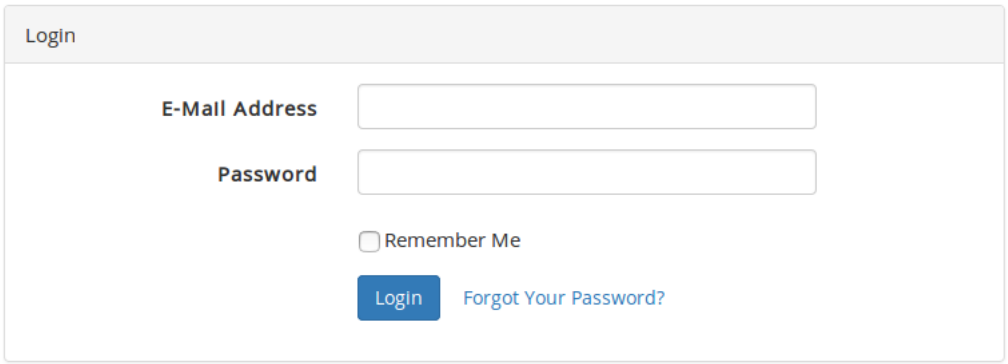
(d) Review :

- The reviewer can optionally modify any question that has been assigned to him/her.
- If the user modifies the question then it is reflected in the version history of that question.
- If the user clicks on No Change button then the question is considered as - "reviewed without any modifications".
- After either of the steps 2 or 3 has been performed, the question is removed from the "To be Reviewed" list visible to the user.

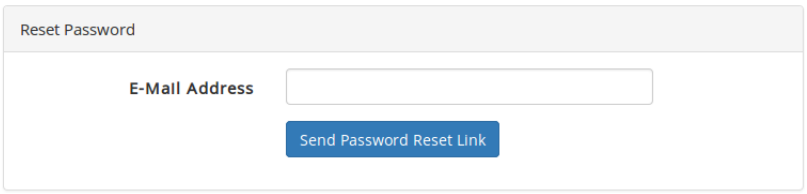
7. History interface
   (a) This Section shows the latest version of all questions and the number of version a question has in the history
   (b) Every question has a button indicating the version number, provided that the question has the version history
   (c) After clicking on the version number button the user is redirected to a new page where there will be display of latest version and n^{th} version of the question
   (d) It contains the following button
      - Cancel : Redirects the users to the previous page
      - Restore : Restores the current version to the specified version

1.5 Use and Demo

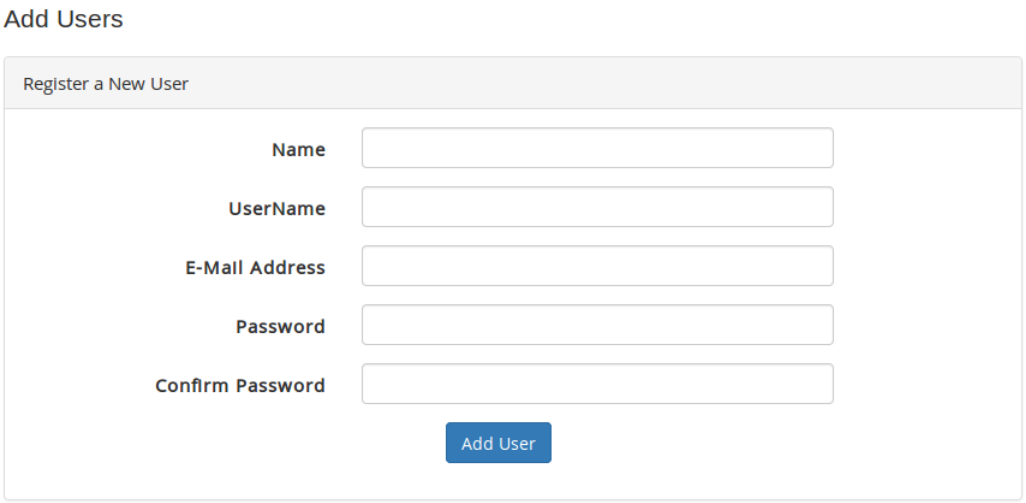
Some glimpses of the application
Login Page



Password Reset link



New User Registration on Admin Panel



List of Users

View or Delete

Name	Username	E-Mail	Created at	Updated at	Remove
Uttam K Gupta	UkGupta	guptauttam@gmail.com	2016-07-22 19:23:25	2016-07-23 14:18:36	Delete
Yogita Mali	maliyogita	maliyogita93@gmail.com	2016-07-22 19:32:10	2016-07-22 19:32:10	Delete
tushar	tusharshah@	tushar@gmail.com	2016-07-22 19:52:38	2016-07-23 14:11:24	Delete
qwerty	qwerty	qwerty@gmail.com	2016-07-22 19:56:16	2016-07-22 19:56:16	Delete
qwerty	qwerty123	qwerty123@gmail.com	2016-07-22 20:02:07	2016-07-22 20:02:07	Delete
zxcvb	zxcvb@gmail.com	zxcvb@gmail.com	2016-07-22 20:41:25	2016-07-22 20:41:25	Delete

Adding new Tags by Admin

Tags

Add Tags

Add a New Tag

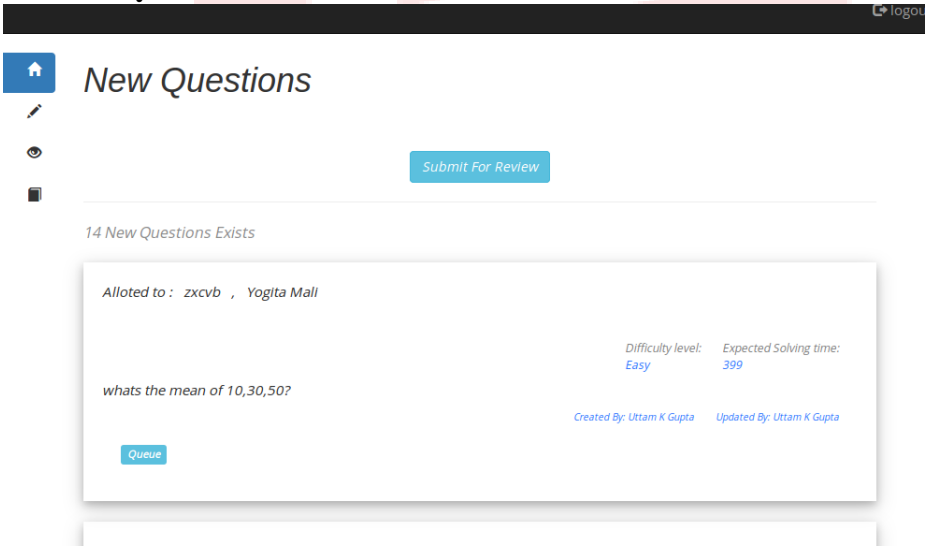
Tag Name

Add Tag

Displaying current tags

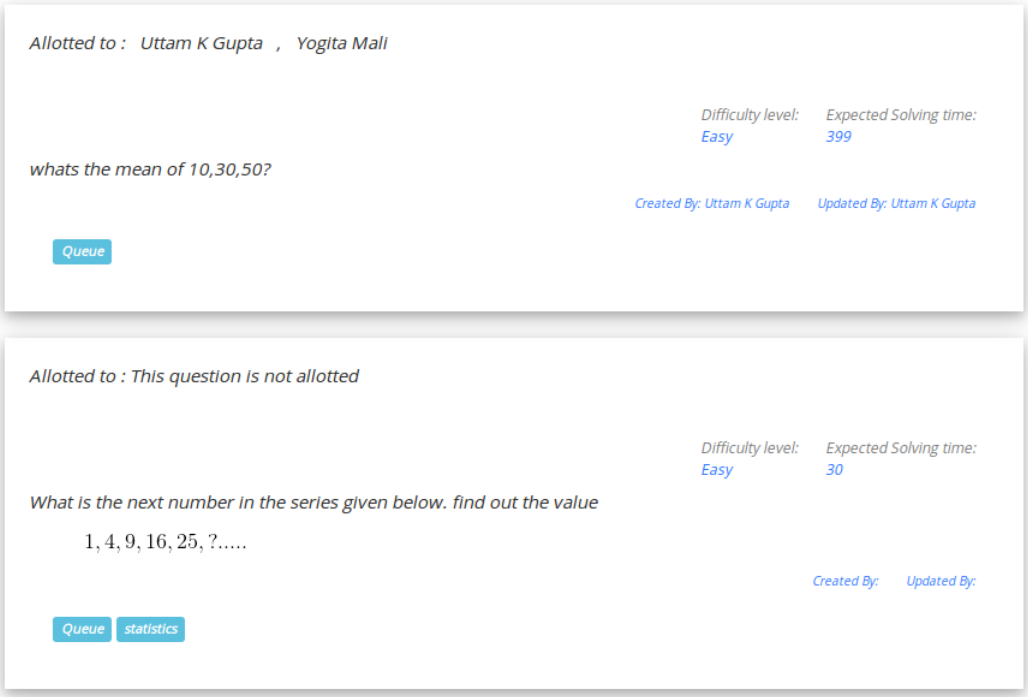
No.	Name	Created at	Updated at	Remove
1	artificial	2016-07-07 17:33:58	2016-07-07 17:33:58	Delete
2	algorithm	2016-07-07 17:33:58	2016-07-07 17:33:58	Delete
3	integration	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
4	Queue	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
5	stacks	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
6	binary tree	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
7	heap	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
8	greedy algorithm	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
9	definite integral	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete
10	differentiation	2016-07-07 18:43:44	2016-07-07 18:43:44	Delete

New Question for review on Admin Panel



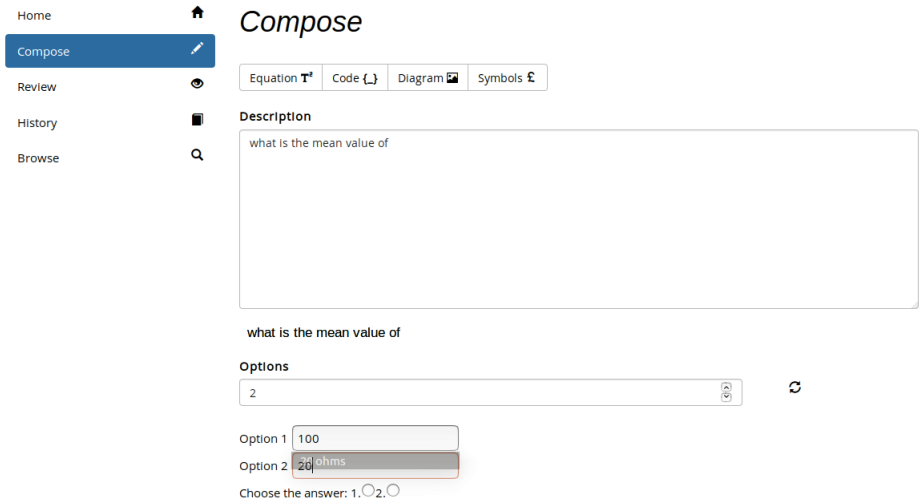
Indication for Review Allotment status

15 New Questions Exists

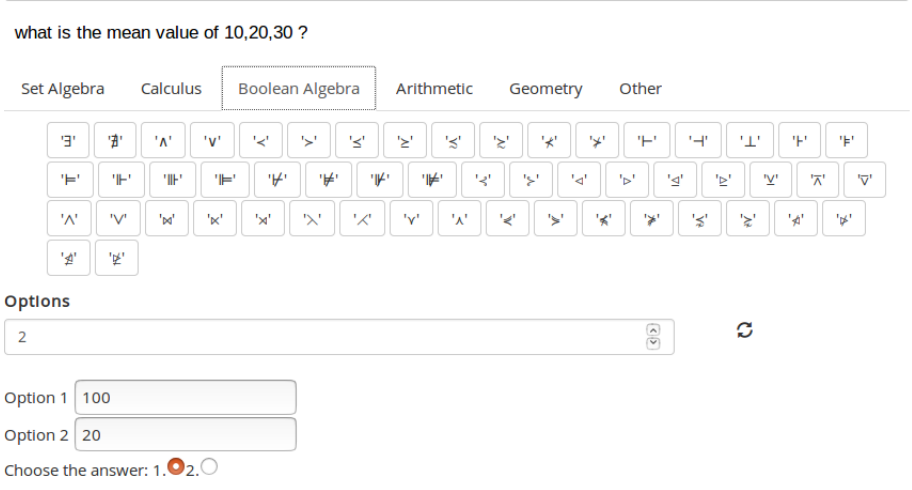


For Users

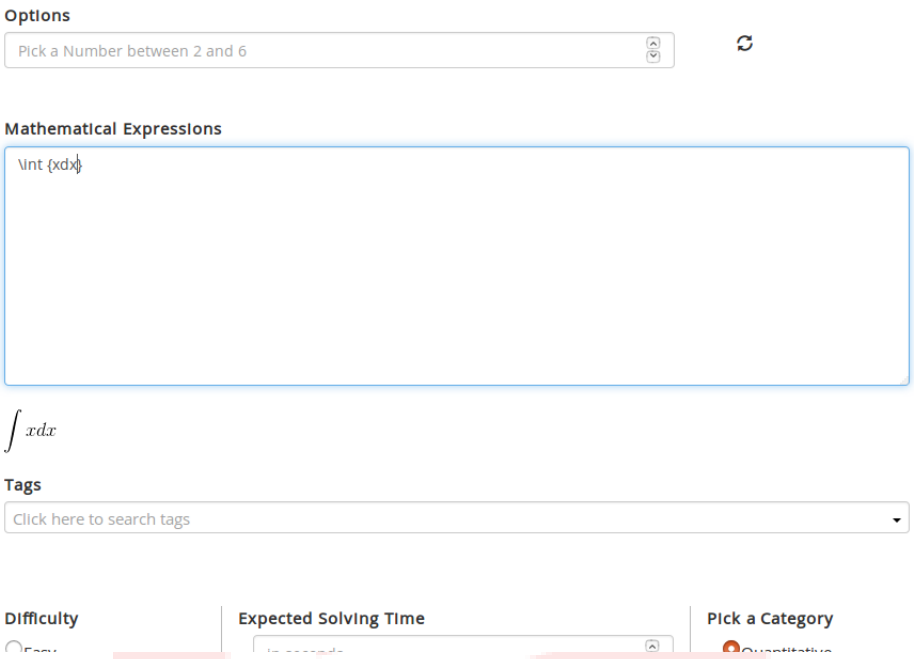
Text to image conversion and options



Special Symbol keyboard



LaTeXto image conversions



Code to image conversion

$$\int xdx$$

Add Code

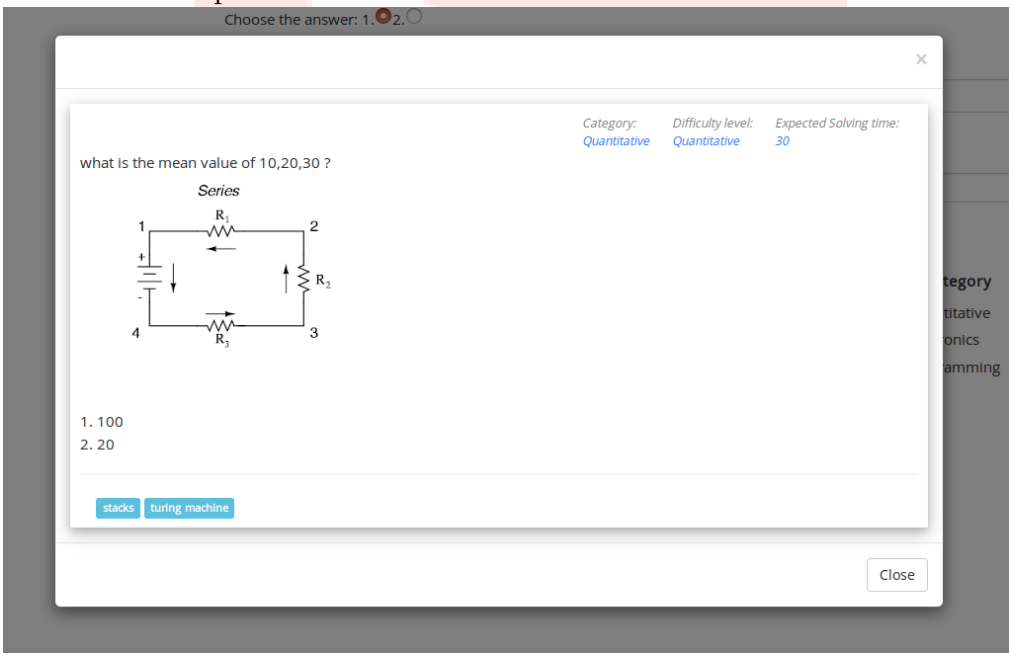
```
int a = b + c;
```

```
int a = b + c;
```

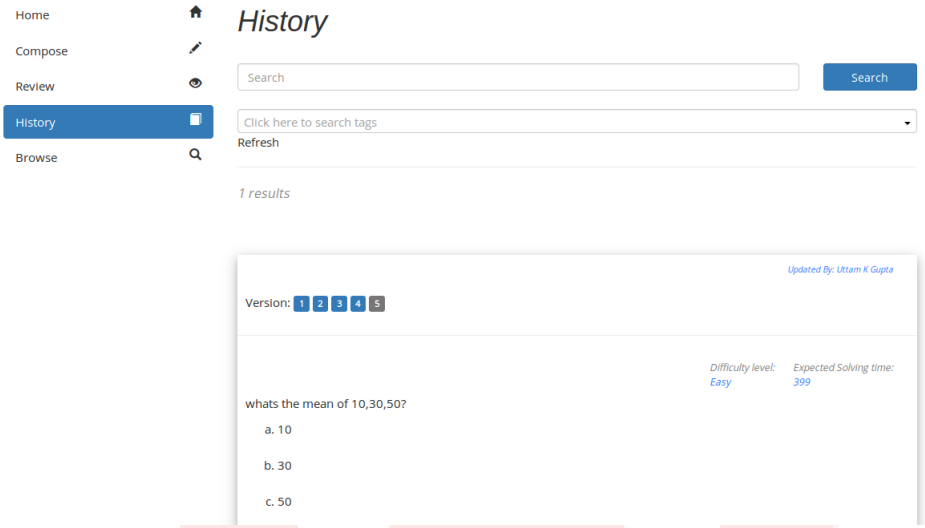
Tags

Click here to search tags

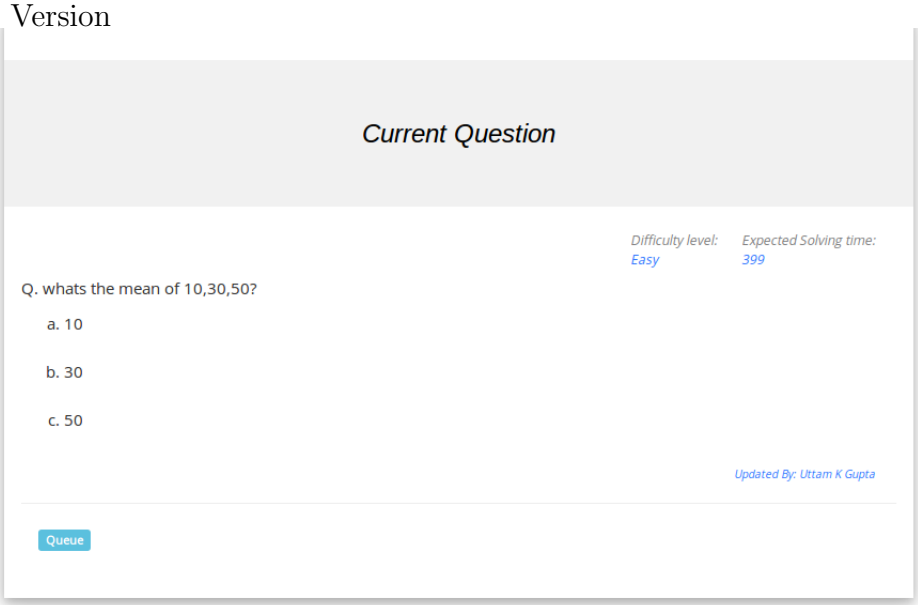
Preview of question before submit



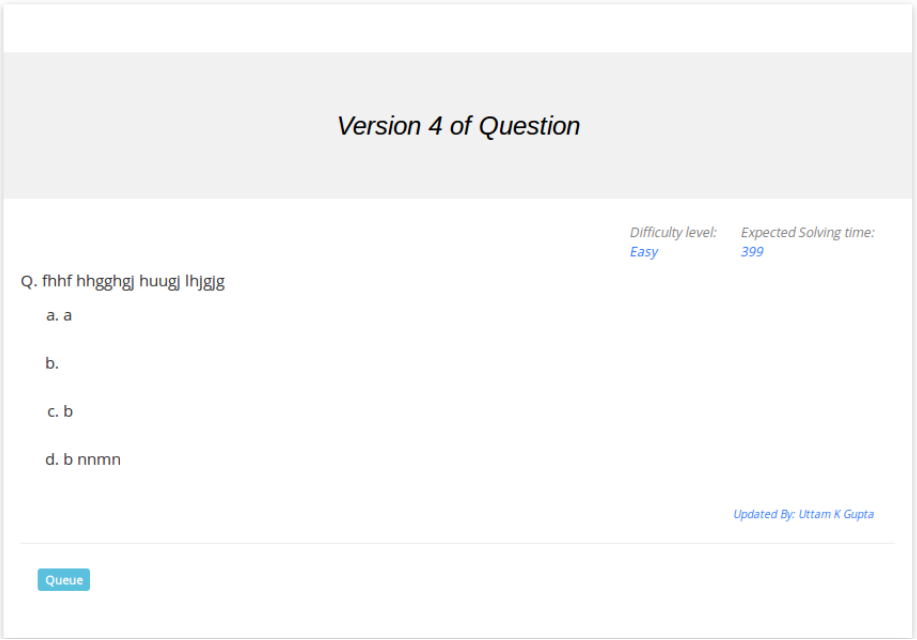
History interface



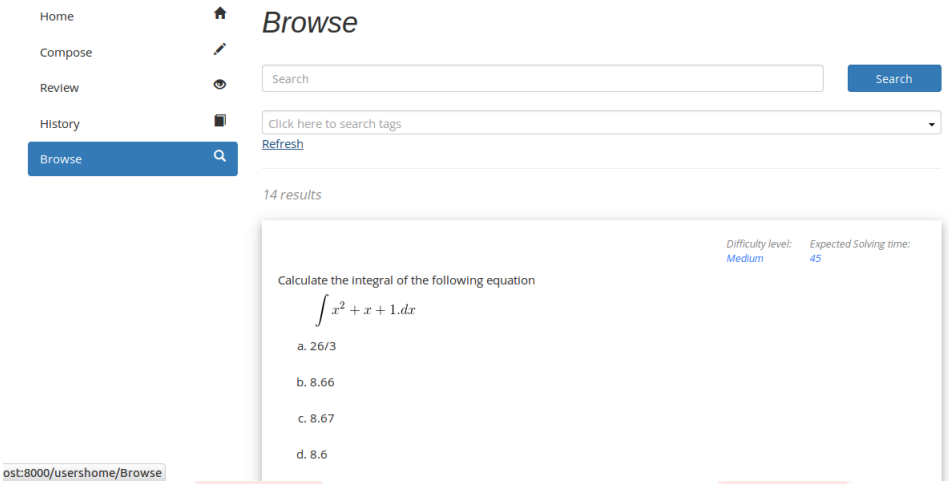
New Version



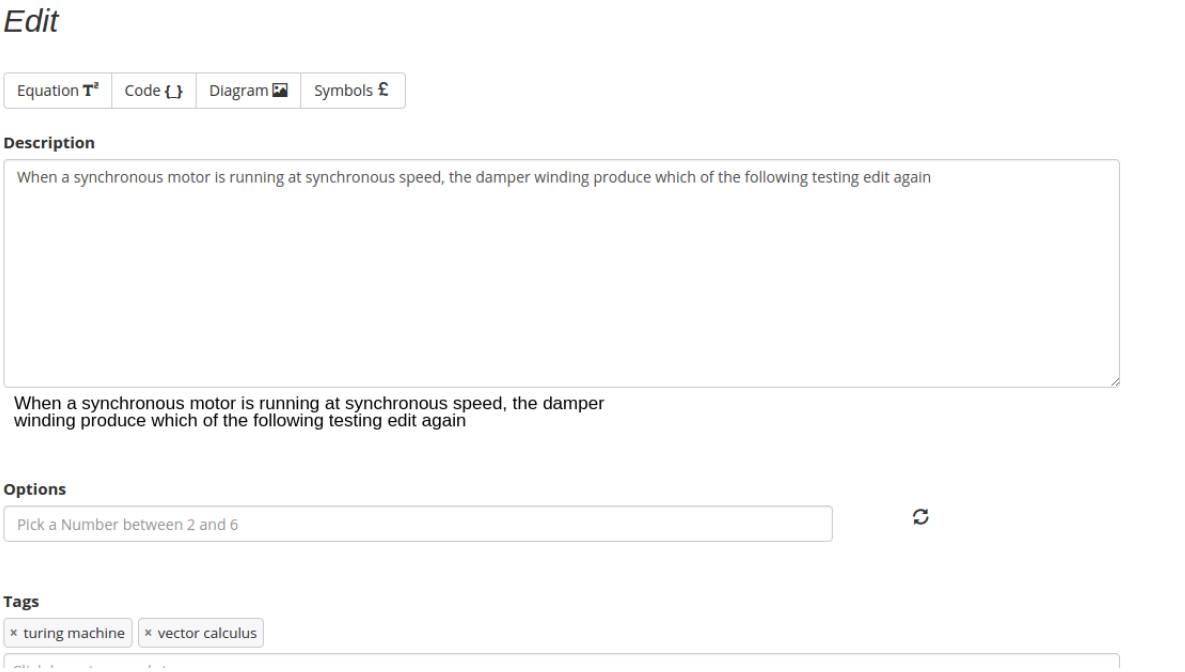
Old Version



Browsing the question bank



Edit a question




Picking a Question
Pick
Equation
Code
Diagram
Symbols
Description
When a synchronous motor is running at synchronous speed, the damper winding produce which of the following testing edit again
When a synchronous motor is running at synchronous speed, the damper winding produce which of the following testing edit again
Options
Pick a Number between 2 and 6
Tags
× turing machine
× vector calculus

1.6 Future Work

- Interesting insights can be gained by performing mining operations on the data generated in the system
- As every application has scope for improvement, studies can be done to develop various algorithms for distribution of questions in more selective and organized manner(as per categories or sub-categories, or difficulty level)
- The application has a coding window. APIs that give results of the code being typed and allow features such as auto-indentation can also be integrated into the existing system
- An algorithm for automating the process of creating question sets using the existing question bank can be created, each of which is of the simillar difficulty level.

1.7 Bug report and Challenges

- Challenges
  1. Designing a good UI
  2. Since the database is in the Boyce Codd Normal Form, developing efficient queries for merging data was a challenge
  3. Creating the database that shall not suffer major modifications in the long run
  4. Text to image conversion

Bibliography

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Documentation Link

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Tutorial Link

[3] Laracast Discussion Forum
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[8] Bootstrap Tutorial
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