INTERACTIVE COURSE QUESTION SYSTEM

Senior Design Project II

Melis Akarçay

2020

MEF UNIVERSITY
FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

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Advisor: Dr. Şuayb Ş. Arslan

Co-Advisor: Dr. Şeniz Demir

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Project Title   : Interactive Course Question Database
Student(s) Name   : Melis Akarçay
Date   : 10/06/2020

I hereby state that the design project prepared by Melis Akarçay and Uğur Boran has been completed under my supervision. I accept this work as a "Senior Design Project".

10/06/2020
Dr. Şuayb Ş. Arslan

I hereby state that I have examined this senior design project by Melis Akarçay and Uğur Boran. This work is acceptable as a "Senior Design Project".

10/06/2020
Muhittin Gökmen

Head of the Department of
Computer Engineering

ACADEMIC HONESTY PLEDGE

In keeping with MEF University Student Code of Conduct, I pledge that this work is my own and that I have not received inappropriate assistance in its preparation. I further declare that all resources are explicitly cited.

NAME   DATE   SIGNATURE

Melis Akarçay   10/06/2020

ABSTRACT

Interactive Course Question System

Melis Akarçay

MEF UNIVERSITY
Faculty of Engineering
Department of Computer Engineering

Advisor: Dr. Şuayb Ş. Arslan
Co-Advisor: Dr. Şeniz Demir

JUNE, 2020

The system in this project aims to show users various questions along with the degree of difficulty related to these questions. While creating this system, the idea of creating a question system for students and bringing them to more questions was started. Students can reach questions about the subject they want to work with in this system. When choosing a question, the student can see whether it is difficult or easy. In this way, he gets information about the difficulty level of the problem before responding to the question. At this point, the main goal can be defined as motivating the student with the information obtained. The main motivation of such a project is to prepare smart-practice-making systems for students in an online environment whereby pandemics such as COVID-19 may interrupt the classical education system.

When each student solves the question, their answer is stored in the system. At the same time, after each completed question, the student is given the chance to choose a level of difficulty and make comments for the question just like in Youtube. In accordance with these three data, the difficulty level of the problem is decided.

Keywords: Django Framework, Natural Language Processing, Artificial Intelligence

ÖZET

Interaktif Kurs Soru Sistemi

Melis Akarçay

MEF ÜNİVERSİTESİ
Mühendislik Fakültesi
Bilgisayar Mühendisliği Bölümü

Tez Danışmanı: Dr. Şuayb Ş. Arslan
Eş-Danışman: Dr. Şeniz Demir

HAZİRAN, 2020

Bu projedeki sistem kullanıcılara çeşitli sorular ve bu sorularla ilgili zorluk derecesini göstermeyi amaçlamaktadır. Bu sistemi oluştururken, öğrenciler için bir soru sistemi oluşturma ve daha fazla soruya getirme fikri başlatıldı. Öğrenciler bu sistemle çalışmak istedikleri konu hakkında sorulara ulaşabilirler. Bir soru seçerken, öğrenci zor ya da kolay olup olmadığını görebilir. Bu şekilde, soruya girmeden önce sorunun zorluk derecesi hakkında bilgi alır. Bu noktada, temel amaç öğrenciyi elde edilen bilgilerle motive etmek olarak tanımlanabilir. Böyle bir projenin temel motivasyonu, COVID-19 gibi pandemilerin klasik eğitim sistemini kesintiye uğratabileceği durumlarda çevrimiçi bir ortamda öğrenciler için akıllı pratik yapma sistemleri hazırlamaktır.

Her öğrenci soruyu çözdüğünde, cevapları sistemde tutulur. Aynı zamanda, çözülen her sorudan sonra, öğrenciye bir zorluk seviyesi seçme ve soru hakkında yorum yapma şansı verilir. Bu üç veriye göre, sorunun zorluk derecesine karar verilir.

Anahtar Kelimeler: Django, Yapay Zeka, Doğal Dil İşleme

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LIST OF ABBREVIATIONS

SVM   Support Vector Machines

PCA   Principal Component Analysis

LDA   Linear Discriminant Analysis

NLP   Natural Language Processing

1. INTRODUCTION

Accessing information online is very important today. As the use of technology has become widespread, the demand for the digitalization of education has started to increase. The extraordinary situation due to Covid-19 revealed the importance of online education. As pandemics may be impacting our world pretty seriously, education must go on over the online platforms. Interactive course question system is a questioning and answering site to address such challenging times. As the interactive question system can be created separately for each school, instructors can easily check the status of their students through the system. In this way, the communication between students and the instructor will continue in a more interactive way. Instructors will be informed about the status of their students and will be able to continue their student-oriented education. Using the system, the instructors can identify issues that are challenged by students and focus on that point. The system also aims to overcome the problems that students may experience in reaching sample questions while studying. In classical methods, students deal with questions through books. However, it can only reach unlimited resources by using only a computer and internet today. It is important to provide students with a reliable source of questions, to support them in the education process. In the system, it is aimed to provide the students with a score page that keeps the questions they solve and reach the wrong questions they have done in the past. Hence, students can study according to the problems they have difficulties by looking at the questions they made wrong while studying. Since the system is an online platform, users will have the convenience of using it whenever and wherever they want. One more benefit of online platforms is that the student learns how to plan time and takes responsibility for studying [1]. Also, as a result of the increasing use of technology, students' interest in lessons dissipates. For this reason, it is of great importance to reach students with the right method. Within the system, students or instructors will be able to post questions about lessons and topics. These questions will be presented to other users via a thin-client web interface.

The questions on the site are mainly divided into two as basic and non-basic. The reason for this differentiation is that when basic questions are answered incorrectly, they show the correct answers directly to the user, while others show the suggestion video added by the user. The system analyzes the difficulty ratio of the question according to users' feedbacks. While doing the analysis, the system uses correctness ratio of the question, the

1

rating about the difficulty of the question, and the comment about the question. Correctness ratio and rating about the difficulty are set of data we can use directly or indirectly. The third data, the comments, is in text format and each user writes a different content and sends it to the system. For this data to be available, it must be processed and translated into a more comprehensive data type.

The purpose of this project is to provide a platform of questions that students of the school can reach. In this term, the part that shows the question's difficulty information by using all the recorded data will be implemented to the system. Calculation of the difficulty level is to give the student advance information about the question. In this way, when the user chooses a difficult question and answers incorrectly, the user will understand that this problem is difficult and that many people think about it and give an incorrect answer.

1.1. Motivation

The main motivation of this project is to help students in their lessons. Students will be able to access more questions using the system and share the questions they find with others. By this system, it is aimed to create an online platform for users, which can be accessed using the internet and laptop only, with low costs. Thus, students will have reached a question pool using the resources they already have. At the same time, it is aimed to enable instructors to make a more interactive education by checking the status of students from this system. The motivation of the component to be made this term is to create a new dataset and NLP tool for Computer Engineers to use and consolidate the online education platforms. With this study, information obtained from users such as rate, comment analysis, and correct resolution rate will be shown to the user in order to have information about the question apriori. Since users can access all the information concretely, they can observe the responses of the previous users by using this data. It is aimed to create a system where users will discover that a problem that seems to be difficult can be solved easily and with a little attention. The main goal is to motivate the user and share the results obtained as transparently as possible.

1.2. Broad Impact

The created system will provide students with a wide range of questions on a purely online environment. It would also help them study for their exams with the help of a computer and internet connection. It is also aimed to decrease the prejudices to the questions by allowing the students to easily access the difficulty data regarding the questions. With this system, students will be able to observe that one question has difficulty in others or that even if it is an easy question, it can be answered incorrectly when it misses a simple point. With this solution, people can learn about other users' experiences about the question. While the comments and ratings are displayed directly to the user, they can also see the difficulty value calculated with these values.

1.2.1. Global and Environmental Impact

The system only requires a computer and an internet connection, it is very helpful for the environment and uses the minimum amount of infrastructure required for education. Considering how many trees are cut for paper production in the world, making education accessible to everyone by moving education to online platforms will solve a big consumption problem. In addition to the digitalization process of education, creating products that provide the necessary working area for people to continue education in times of pandemic or disaster will enable people to overcome these situations more easily.

1.2.2. Legal Impact

As a result of this system, users can view the total value of the ratings, comments posted, and correct resolution of the question by other users. At this point, the data obtained from the users are made by making certain calculations without showing any personal information to others.

2. PROJECT DEFINITION AND PLANNING

The project aims to process the data received from the user. There are two steps to be followed at this point. The first is to get a degree of difficulty using the comments entered by the user. The second step is to give a special difficulty label to the question using the data

we have. There are three data in the system. These are the values we will get from correctness ratio, difficulty rate and comments.

2.1. Project Definition

The project has two basic applications. The first one is comment classification. A dataset with comments should be prepared in the first place. With this dataset, we teach the machine using Naive Bayes and make a prediction for each new comment entered. Two libraries required to make this application scikit-learn and CoreNLP. Naive Bayes perform the prediction using probabilities. It makes word-based analysis on the data it uses and draws a conclusion with the rates it calculates.

2.2. Project Planning

Table 1. Sample project plan for 14 weeks.

Task	Responsible Person	Weeks													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Literature Survey	Melis Akarçay	▓	▓	▓											
System Modeling and Analysis	Melis Akarçay				▓	▓									
Design of System Part 1	Melis Akarçay					▓	▓	▓							
Design of System Part 2	Melis Akarçay					▓	▓	▓							
Implementation of NLP	Melis Akarçay								▓	▓	▓				
Implementation of Data Analysis	Melis Akarçay									▓	▓				
Testing	Melis Akarçay										▓	▓			
Report and Project Presentation	Melis Akarçay												▓	▓	▓

2.2.1 Aim of the Project

The aim of this project is to determine the level of difficulty related to the questions to be solved using the data obtained from the user. At this point, 3 types of data to be used are obtained by the user. It is aimed to give students information about the question in advance with the degree of difficulty obtained.

2.2.2 Project Coverage

This project covers courses, faculty members, and all of the students. The system covers the database and server.
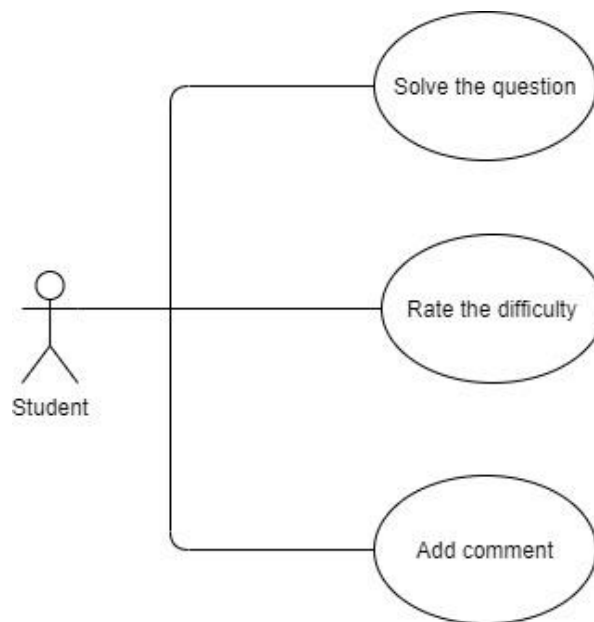
2.2.3 Use Cases

Figure 1. Activities to be done by the user for difficulty calculation

2.2.4 Success Criteria

In general, it is important to make a successful back-end and front-end implementation and make an understandable interface to the user through the Django framework. The other success criterion of this project is to process the data received by the user and indicate the difficulty level related to the questions. At this point, the review of the comments received from the user, designing a user-friendly system and displaying the question difficulty data to user are the main success criteria of the project.

2.2.5 Project Time and Resource Estimation

This project is prepared for the "Senior Design Project II" course of the MEF University Computer Engineering Program. The project is planned to be completed by the end of the 2019- 2020 Spring semester. No major resource is required other than a computer with an internet connection.

2.2.6 Solution Strategies and Applicable Methods

In this project, necessary additions will be made to the question system created for students to determine the difficulty level of the questions. At this point, language processing tools and classification algorithms will be used in the system. When the user solves the question correctly or incorrectly, it is calculated as the ratio and recorded as the correctness ratio associated with the question. Besides, we have two more data, difficulty rate, and comments. Since the comments come in text format, libraries such as Scikit-Learn, Stanford CoreNLP, NLTK will be used to make this data numerical and usable. When all data are obtained, a general difficulty level related to the question will be reached by establishing a decision mechanism.

2.2.7 Risk Analysis

Table 2. Risk analysis table

Risks	Controls
1. Estimation and scheduling	Make a realistic time schedule and apply the schedule.
2. Sudden growth or change in requirements	Planning should be done well and time should be allocated to correct any error.
3. Dataset problems	Alternative solutions should be found when sufficient data cannot be collected.
4. Low accuracy rate	To increase the accuracy rate, necessary procedures, additions should be made or alternatives should be sought.

2.2.8 Tools Needed

Programming Language: Python

Framework: Django

Front-End Design: HTML, CSS

Libraries: Scikit-Learn, NLTK, Stanford CoreNLP

3. THEORETICAL BACKGROUND

In the literature survey section, researches related to the applications similar to the system desired to be created were made. Afterwards, the research was completed by making researches about the project component to be made in this period.

3.1. Literature Survey

The first web-based education system was built by Peter Brusilovsky, Elmar Schwaz, and Gerhard Weber in 1996 [2]. With the newfound intelligent tutoring system ELM-ART, it goes beyond traditional education patterns and gives students the chance to access questions, tests, and explanations remotely.

An online question bank system for schools in Qatar is mentioned in the Journal of Emerging Technologies in International Learning. The main goal of the system is for students to practice and understand their knowledge on related topics. The question bank has two types of users: students and teachers. The system is also designed for students to take exams. The journal also provides information about the results of the use of the system. Researchers mentioned that most of their users are satisfied with the system after the experiment [3].

The parts of the system that will be added in this period are the parts of comment analysis and determining the question difficulty. Therefore, text classification methods are needed. Text classification is a widely used language processing method. With this method, many applications such as spam control, translation, emotion analysis are made. Preparations such as stemming and delete stopwords should be made before the classification process. When the data is cleared, the required data is selected by making feature selection. While machine learning methods are used for text classification, the program classifies them with what they learned from the previous data. There are a few algorithms for implementing the classification. Naive Bayes is the most known algorithm [4]. Naive Bayes classification ability is to find the class of the desired data by making probabilistic calculations. As shown in Table 3 data and tags are defined. First, the probabilities of the categories are calculated with P(C) and P(J). Then, the probability of the words belonging to the categories is calculated. By doing these calculations, the system continues to learn. When test data is

entered, the program uses the possibilities it creates. After calculating the probability for each category, it takes the bigger value and ends its classification.

Table 3. Sentences and their categories

ID	Sentences	Category
1	Chinese Beijing Chinese	C
2	Chinese Chinese Shangai	C
3	Chinese Macao	C
4	Tokio Japan Chinese	J

Another algorithm is Support Vector Machine. Support Vector Machine draws a "line" dividing space into two subspaces. Vectors belonging to one group are located in one subset and other vectors that do not belong to that group are located in another subset. That line should be drawn from the farthest point to the members of the two groups.
A study showed that [5], SVM's accuracy performance is better than Naive Bayes. However, it is remarkable that this difference is very small considering the data.

Cong-Cuong Le at al. (2019) show that Bayes' efficiency can be increased by using a specific dictionary and reducing train time instead of using a dataset full of unnecessary data. It was observed that there could be a 2% increase in accuracy with the data processing before Bayes application. Their research is about making positive and negative sentiment inferences in sentences. They made prediction with Naive Bayes by inserting unlabeled data in the system they trained with the produced sentiment-based dictionary [6].

An important part when creating text classification algorithm is to make the sentence ready for use. The processes to be carried out in the pre-process and classification section are proceeded in Fig. 2 [7].
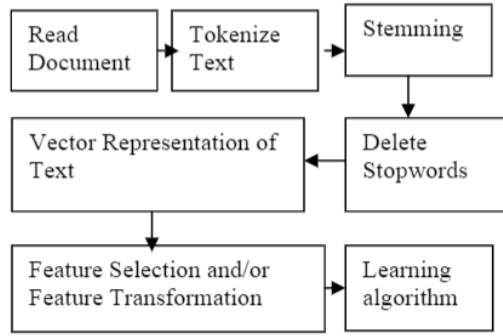
Figure 2. Text classification steps [7]

Stanford CoreNLP is a Java-based tool for language processing. CoreNLP is a tool with a wide variety of text analysis and API for many programming languages. With CoreNLP, linguistic analysis can be easily made to a sentence. In addition to containing many basic annotators, it even includes a sentiment analyzer [8]. CoreNLP includes sentiment analysis tools as well as basic annotators such as POS (part-of-speech), lemma, and tokenize [Fig. 3, 8].
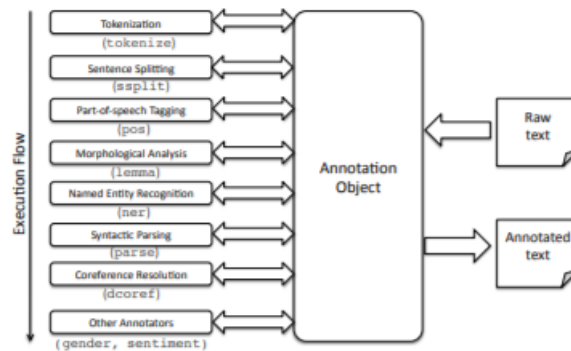

Figure 3. Stanford CoreNLP system [8]

3.2. Solution Method

Django framework was used for interface integration to create the basis of the system. After creating a database and interface to meet the basic needs of the user, some data obtained from the users were calculated using basic statistical metrics. These data are the number of correct resolution of questions and the degree of difficulty votes. The results obtained were made available in this way. NLP tools were used in the smart-system implementation, which is yet another part of the system, required for comment analysis and determining an overall difficulty level. Language processing tools and algorithms must be used to implement comment classification. A labeled dataset is used as data. These data will be used to train the system with Naive Bayes method and each new sentence will be taken as test input for the system. As it has a limited data set, a hybrid approach will be created by using the Stanford Sentiment Tool [9] next to Naive Bayes. The data obtained will produce results with a decision tree mechanism. After the process of obtaining the data, the interface will be developed by adding figures that can be easily perceived to give the necessary feedback to the users.

4. ANALYSIS AND MODELLING

4.1. System Factors

We believe some factors such as insufficient data set, problems that may occur in Stanford CoreNLP Server, and not getting enough data from users can adversely affect the system operation.

4.2. How System Works

In order for a user to use the system, they must first log in or get a new membership if they are not a member. After logging in, the user first chooses the desired course by entering the Explore section. The user is made up of the question list by choosing from the list of topics. When the user chooses the question, multiple-choice answers appear. When a question is solved in the system, the correct or false value of each user when it is first solved is recorded in the database. Thus, it is aimed to have a higher accuracy rate when making calculations. After the user chooses the answer, the system gives feedback about whether the answer is correct or not. In the next step, the user can rate the difficulty of the problem and post comments. Also, students can see the previous questions that they have solved on the final score page.

The system performs an analysis on the inputs received from the user. The user provides 3 different data entries while using the system through interacting with the questions. These are whether the problem is solved correctly, rate, and comments. In the system, if the problem is solved correctly and the rate can be kept with the number value, the comment needs to be processed in order to be converted to the numeric value. The system tries to convert comments to numeric values using a hybrid approach. Finally, the system combines all the data and tries to determine the level of difficulty.

4.3. Modelling

Django Framework was used while creating the system. Implementation of the back-end, front-end, and database components are provided with Django Framework (see Fig. 4).
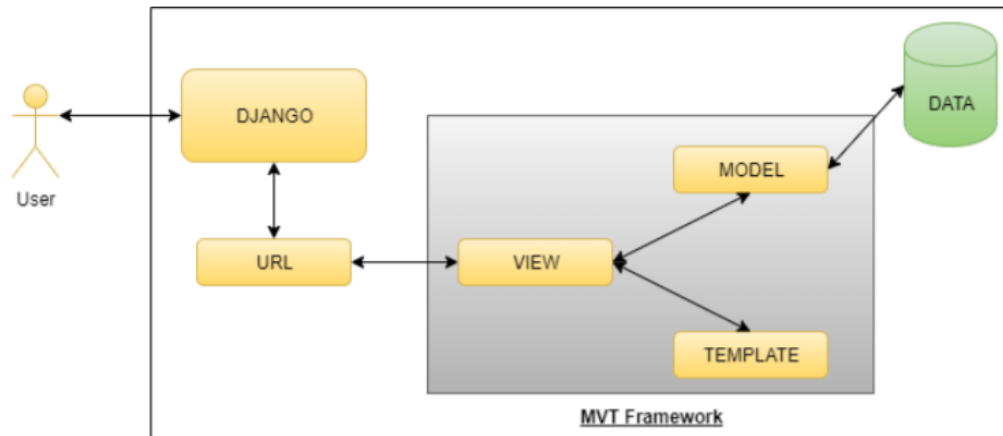

Figure 4. MVT architecture

Database creation of the system done by using the model component function of Django. The main part about Django is addressing the pages with URL and then connecting them to functions in view class. The functions in the View section use the HTML files in the Template section to become visible. Bootstrap framework is used to provide page layout in the front-end of the system. Thus both front and back-end components are designed in a unified fashion using the same framework components. The general flow diagram of the system is as shown in Fig. 5.
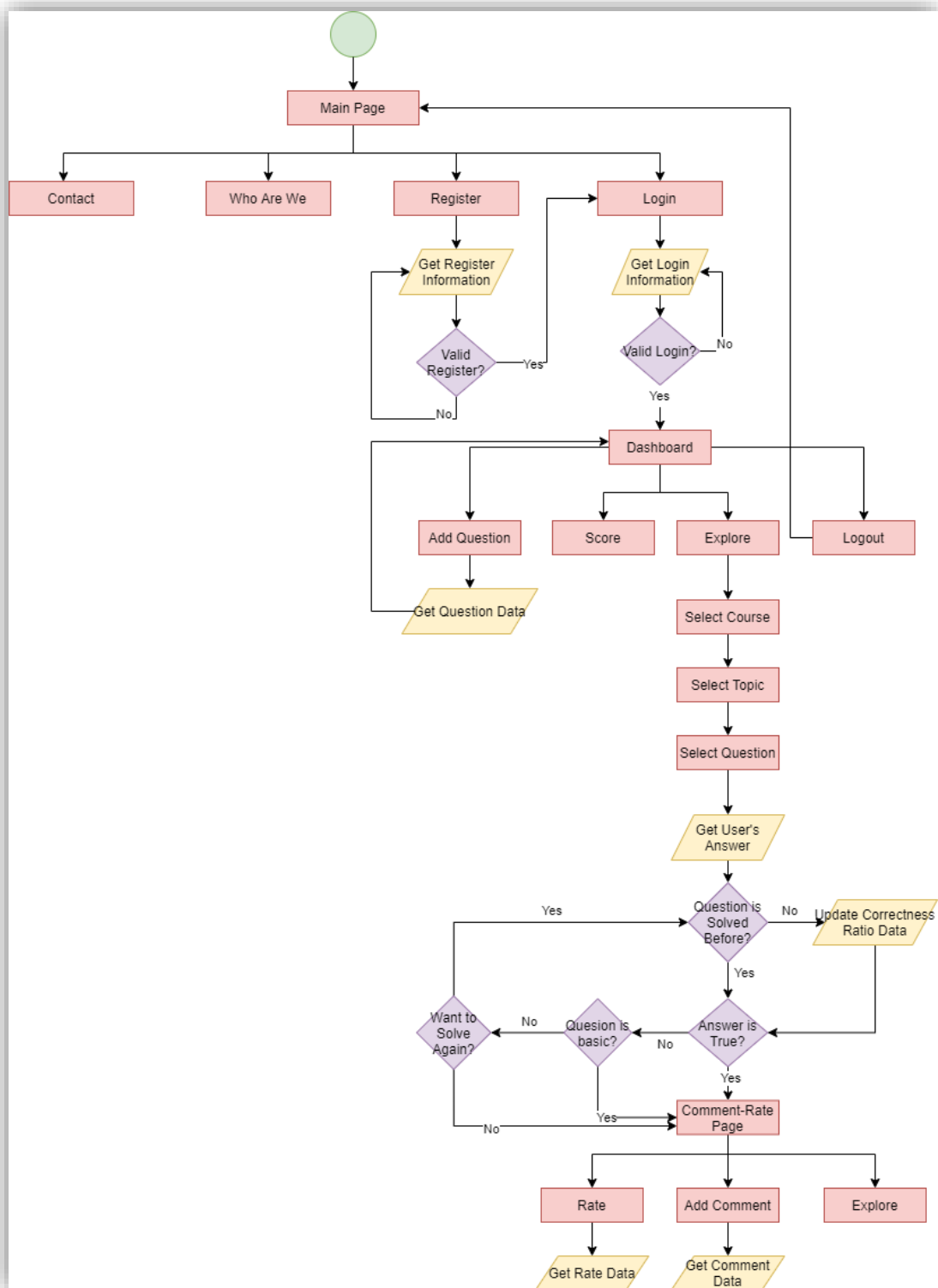
Figure 5. Flowchart of Interactive Course Question System

One of the important points in the system is the conversion of the obtained analysis results into numerical values. Results of text classification and sentiment analysis is converted into numerical values as shown in Table 4.

Table 4. Integer values of comment classifiers

Text Classification	Sentiment Analysis
3 : Hard	3 : Negative
2 : Medium	2 : Neutral
1 : Easy	1 : Positive

After the hybrid approach of text classification and sentiment analysis, there should be a comment label. As mentioned before there are also two more values that stand for a corretness ratio and difficulty rate of the question. These data are also stored as numeric values in the database. Values related to the degree of difficulty are taken as numbers to make them usable, but the correctness ratio where the correct resolution of the problem is observed is stored as a percentage. Instead of using the correctness ratio value as a percentage, it was implemented as in Table 5 by giving certain integer values.

Table 5. Integer values of user feedbacks

Correctness Ratio	Difficulty Rate	Comment Analysis	Overall
3 : 0 ≤ C < 35	3 : Hard	3: Hard	3: Hard
2 : 35 ≤ C ≤ 55	2 : Medium	2 : Medium	2 : Medium
1 : 55 < C ≤ 100	1 : Easy	1 : Easy	1 : Easy

4.3.1. System Architecture

The basis of the system was built using Django framework. When using SQLite for the database, functions are written in Python and the front-end section is made using HTML and CSS. Scikit-learn, Stanford CoreNLP, and decision tree were used in the construction of the system's difficulty analysis component. Since there is no ready-made data set on the subject, the data set was prepared manually. At the same time, sentiment value of the sentences was obtained by using the Stanford CoreNLP sentiment tool.

5. DESIGN, IMPLEMENTATION AND TESTING

5.1. Design

The basic parts of the system were made using the Django framework in the previous semester. Significant features such as membership in the system, score page to see previously solved questions, adding questions, and solving questions have been added. The main motivation for the design of the project's analysis component is to make the data kept by the system visible to students. The correctness ratio showing the correct answering rate of the questions and the difficulty rate obtained from the user were calculated using the basic statistical metrics. A dataset was created from the comments written about the questions. All sentences were labeled and made ready for use. Afterward, it was decided to make a word-based classification with using Naive Bayes. The results obtained were classified using the decision tree.

5.2. Implementation

The created data set has been uploaded to the project and words in sentences are processed with Stanford NLPCore. It is important for the words in the sentences to be longer than 2 letters and the words that can make sense such as verb and adjective, to shorten the processing time. Before text processing, such as stemming and stop world deletion were done. The words in the sentences are separated in the same way and the most suitable label is found by using Naive Bayes Classifier. Since the data set is not rich enough, Stanford CoreNLP Sentiment Tool has been added to support the system. CoreNLP is a Java-Based tool so pycorenlp API used for implementation. Sentiment value is taken from the JSON file obtained by using CoreNLP annotator. However, another point here is to make sure that the values that are the result of both text classification and sentiment analysis available in the system.

While adding functions to the system, the interface was developed to be compatible with these plugins. It is very important for this project that the obtained data is visible to the user. Therefore, an interface was designed to share the results obtained with the user even after the comment was added (see Fig. 6).
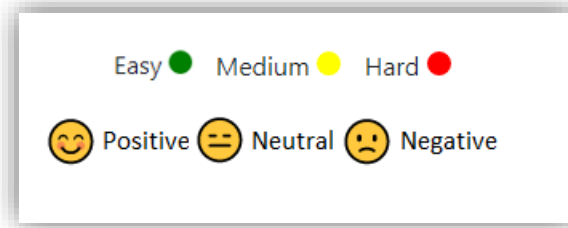
Figure 6. Label visualizations

After adding the visualization part, the view of the comment page was as shown in Fig. 7.
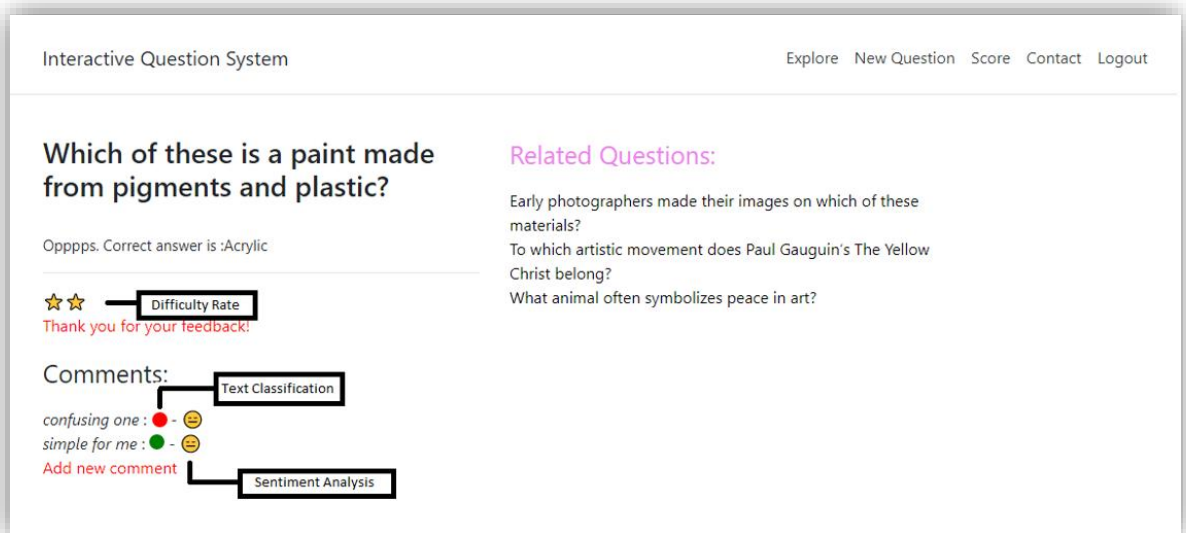

Figure 7. Comment classification output in the system

Another user-based data taken and calculated in the system is the difficulty rate. Difficulty rate is made by taking an easy, medium, or hard evaluation from the user through buttons. Values such as comment, whether the problem is solved correctly and difficulty rate rating are taken once from each user. Thus, it is aimed to increase the accuracy rate in the system.

In the next step, the numbers obtained must be evaluated in order to give an overall value to the sentence. The decision tree shown in Fig. 8 has been created for the sentences to take value. DecisionTreeClassifier method of Scikit-Learn library is used to provide a decision mechanism.
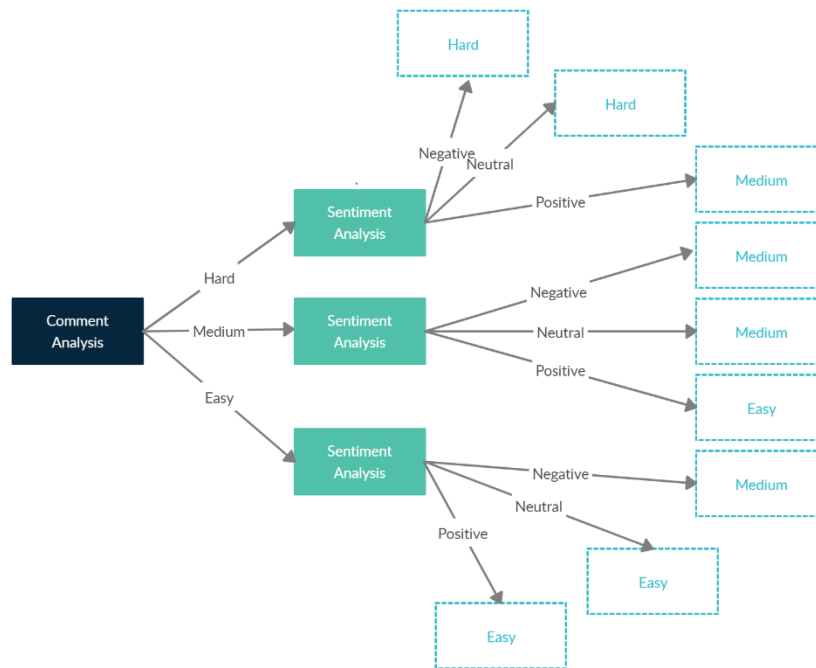
17

Figure 8. Comment classification decision tree

An overall difficulty value is tried to be obtained by using all the data received by the users, namely correctness ratio, difficulty rate, and comment analysis. At this point, a decision tree is used again and information is tried to be provided to the user. As new questions are resolved and users add the requested data to the system, the data stored in the tables in the database will be updated. When the user enters the question page, the page that comes up will be as shown in Fig. 9.


Figure 9. System output

5.3. Testing

This project aimed to make sense of the available data using a hybrid approach. The new data obtained were processed and made readable by the users. This system, which is tried to be produced for students, can be measured with questions answered by the target user. For this reason, the opinions of the target audience were taken with the user experience and survey conducted remotely. The results of the user experience test with 7 participants are shown in Fig. 10. We look forward to improve the participation rate in the future for more meaningful and statistically reliable results.
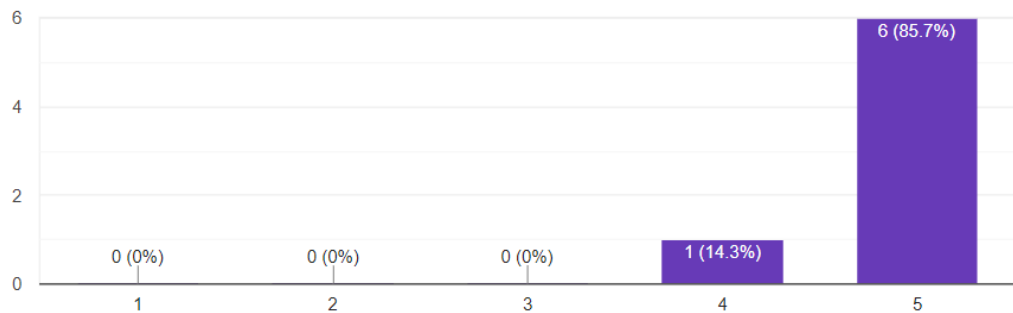
Seeing the difficulty rates about the questions gave me confidence. (1: Strongly Disagree - 5:Strongly Agree)
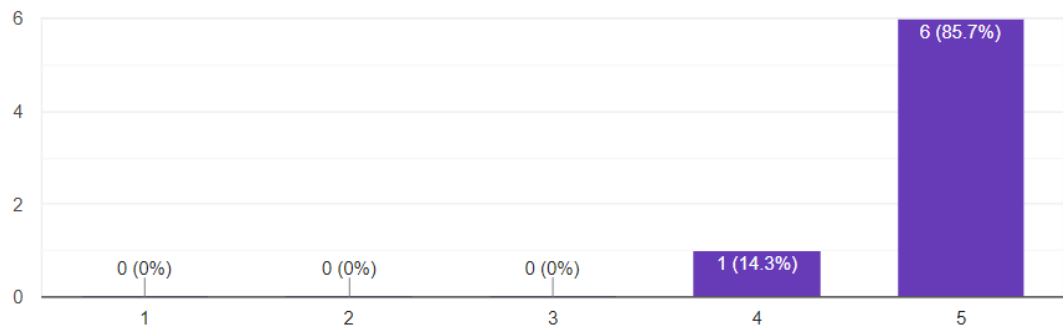
7 responses

I would recommend such a site to my friends. (1: Strongly Disagree - 5:Strongly Agree)

7 responses

The information given about the difficulty of the problem met my expectation. (1: Strongly Disagree - 5:Strongly Agree)
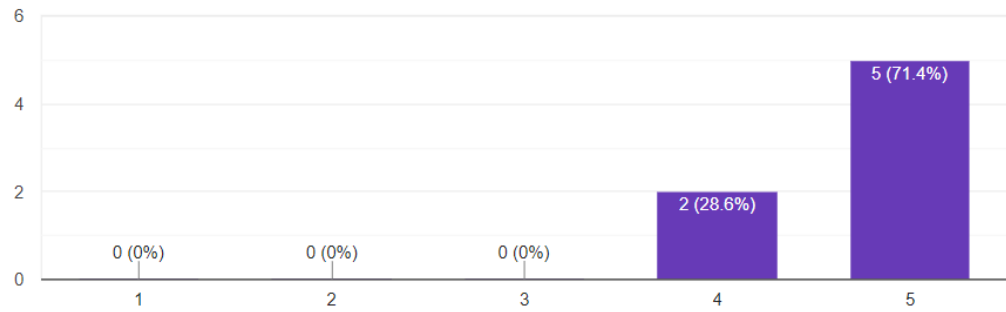
7 responses

Figure 10. UX survey results

6. RESULTS

We have developed a complete online and adaptive interactive question database that would be extremely useful in such harsh and adverse times we have recently gone through where lockdowns were all prevalent all over the globe. Our system achieves this adaptivity through various AI algorithms such as NLP. The structure of the project was created using the Django framework. Using the back-end, front-end, and database relationship facilitated by Django, the system's major features such as adding questions, becoming members, solving questions are added. Membership feature in the system is important for obtaining subjective data adaptation both for users to reach the questions they have solved before and to see their status as well as to perform special question system implementation for the classes. The result we obtained at the end of the project's analysis component is the difficulty rates of the questions. In addition to the difficulty rate obtained based on words with the Naive Bayes method used, we have attempted to combine the results produced with the support of Sentiment analysis with all data and give feedback to the user. Thus, by processing and combining the three input data we received from the user, we obtained data that we can use to categorize the questions. While solving the questions, users can get information about the question by encountering the screen shown in Fig. 9. As a result of the user experience test, it has been determined that such an application may attract the attention of the participants.

7. CONCLUSION

In conclusion, we designed a question system that shares the data it has gradually recorded, aiming to motivate students in case direct face-2-face interactions for education are limited. Within the data obtained as a result of students' interaction in the system, the analysis was made for the questions and their difficulty levels were determined. The system does not leave the student alone with the question. Users will be able to upload and solve questions in a large question bank. Now the student has the opportunity to observe and analyze the reactions of other users before solving the question. The fact that the difficulty values of the questions appear on the system is important both for the teacher to have information about the class situation and for the students not to lose their motivation against the question. At the point of experienced difficulty, the user can consolidate the issue with the suggestion video he comes across. When the student cannot solve the question, the subject can be reinforced by watching the video suggested by the system. In our digital world, the education sector needs to be quickly adapted to the online world. In a situation where education is carried to online platforms, resources are needed to support users during the lesson and study process. Interactive Course Question System aims to complement users with an interactive question solving experience while they are studying a specific subject of their interest.

7.1. Life-Long Learning

The learning process of an engineer never ends. In this simplest project, written using Python, Java-Based CoreNLP is used. And in order to add this tool to the system, it is necessary to find the appropriate API and make sense of the outputs. It is very important to be eager to learn and to be open to new technologies. Most advances in technology directly affect the engineering profession. The amount of information that needs to be learned is passing every day. However, with this increase, access to information has become easier. One of the most important processes while doing the project is to determine the requirements and create a road map accordingly. Whether the things needed are in the project owner or not is one of the main factors that make up this map. For this reason, the developer needs to know its shortcomings.

7.2. Professional and Ethical Responsibilities of Engineers

It is a very important ethical element to make use of the experience of other engineers and to share your experiences with others while making projects. Thanks to the information and guidance I received from my advisors, I was able to determine a more comfortable road map. It is also very important to maintain and maintain the system produced. Engineering is not just about producing and selling a product. The sustainability of the product is again under the responsibility of the engineer. Therefore, the development of products should continue in line with the developments in technology.

7.3. Contemporary Issues

Education is one of the sectors that will be most affected by the digitization process. As a result of technology development, the rate of phone usage in children and teenagers increases. At a point where students are so accustomed to technology, it is necessary to support them with digitalized educational tools. Question applications supported by artificial intelligence, children's games produced using augmented reality and virtual reality technology can be useful in the education process.

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