

An Intelligent Conversational Agent with Text Classifiers

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A conversational agent is a computer program that performs an online communication using text or text-to-speech technology

The main goal of the conversational agent is to chat with people and doing various redundant tasks easier for people.

Conversational agents provide effective customer service, and due to this, it will highly benefit businesses and society.

The project is an application that allows users to converse with humans using artificial intelligence principles. As a reference implementation, the receptionist role of a university is chosen to demonstrate the proposed solution.

Literature Review

| Title of papers | Author and Year | Journal Source | Major Insights | Research Gap |
|--|---|---|---|---|
| Survey on various conversational systems | Fernandes, S., Gawas, R., Alvares, P., Femandes, M., Kale, D., & Aswale, S., 2020 | International Conference on Emerging Trends in Information Technology and Engineering (ic-ETITE). | <ol style="list-style-type: none"> 1. Conduct a survey to compare already existing chatbots with respect to platforms used, algorithms applied, tools and software used, etc. 2. This paper specifies Dialogflow as the Conversation Interface. 3. Under Medical domain, the data mining model which gives the best accuracy for predicting these disease from heart disease dataset was the Support Vector Machine algorithm. 4. Matlab and Weka tools were used for analysis purposes including pre-processing, clustering, and graph plotting. | <ol style="list-style-type: none"> 1. Since none of the algorithms give 100% accuracy, it can sometimes give wrong output for a chatbot in the medical domain, which can lead the user to go under unnecessary medication and cause a waste of money & time. 2. Thus, maintaining such accuracy and user satisfaction is a limitation of this project |
| Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services | Agus et al. 2018 | International Seminar on Application for Technology of Information and Communication, 2018 | <ol style="list-style-type: none"> 1. A mobile application system, named Alpha, that utilizes chatbots as smart teaching assistants. 2. The system consists of an artificially intelligent (smart) chatbot (Dialogflow framework) , cloud-based database(Google Firestore) , speech recognition, and web services. 3. The average SUS score is seventy-seven which translates into an 80% percentile rank. | Currently, course information is uploaded to the chatbot in a semi-automated manner, implementing a fully automated process can be more productive and easier for educators and admin users. |
| AI Reception: An Intelligent Bengali Receptionist System Integrating with Face, Speech, and Interaction Recognition. | Nabid, R. A., Pranto, S. I., Mohammed, N., Sarker, F., Huda, M. N., & Mamun, K. A. 2022 | In International Conference on Bangabandhu and Digital Bangladesh | <ol style="list-style-type: none"> 1. AI-based Smart Reception that can authenticate users and communicate with humans in Bangla by replying to university-domain-related inquiries. 2. The Interaction Recognition system consists of three modules: Automatic Speech Recognition (ASR), Interactive Agent, and Text-to-Speech (TTS) Synthesis. 3. Validated the developed database management architecture for the Interaction Recognition system with the three-step evaluation using BERT sentence transformer (paraphrase-mpnet-base-v2) that provided satisfactory responses with 92% accuracy | <ol style="list-style-type: none"> 1. The WER of the Deep Speech 2 model is not up to the mark, in the future, it need to train a neural network-based language model and perform noise augmentation to reduce the WER at a significant level. 2. The system can be made more user-friendly and robust by integrating face identification and sentence summarizing. |

Literature Review

| Title of papers | Author and Year | Journal Source | Major Insights | Research Gap |
|--|---|--|---|---|
| Chatbot for university related FAQs | B. R. Ranoliya, N. Raghuwanshi and S. Singh, 2017 | International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2017 | <ol style="list-style-type: none"> The design of a chatbot, which provides an efficient and accurate answer for any query based on the dataset of FAQs using Artificial Intelligence Markup Language (AIML) and Latent Semantic Analysis (LSA). Chatbot is implemented to meet the academic needs of the visitors. | Chatbot can enhance by including and changing patterns and templates for general client queries using AIML and right responses are given more often than not utilizing LSA. |
| An intelligent question answering conversational agent using Naïve Bayesian classifier | M. Niranjan, M. S. Saipreethy and T. G. Kumar, 2012 | IEEE International Conference on Mobile Data Management (MDM), Daejeon, 2017 | <ol style="list-style-type: none"> Its an automated question answering system answers the queries posted by the student in a more interactive way like a virtual teacher (chatbot system). The Q&A knowledge base can be accessed and modified by the instructor who could also know the areas where the students are more prone to doubts thus helping the student as well as the instructor. The Bayesian algorithm categorizes the question answer provided by tutor. | <ol style="list-style-type: none"> The performance of the system is vastly dependent on the size and accuracy of the databases. There is a possibility of a large number of semantically similar questions which may go unidentified by the system unless the teacher considers the semantically similar words to be includes in the terminology section. |

Problem Statement

Technical | Functional

1. The generic conversational assistants do not have knowledge about very specific domain and specific problems.
2. Multiple students cannot be handled by single receptionist. There will be a delay in getting answers. The receptionist would not be knowing all the answers to the student's question, so they have to refer to and get the answers from authorities.
3. Provide 24/7 support: Around-the-clock support would not be available from the university front desk. Otherwise, the university has to employ more than a single person to attend to students around the clock.

Project Objectives

Primary & Secondary Objectives | Expected Outcome

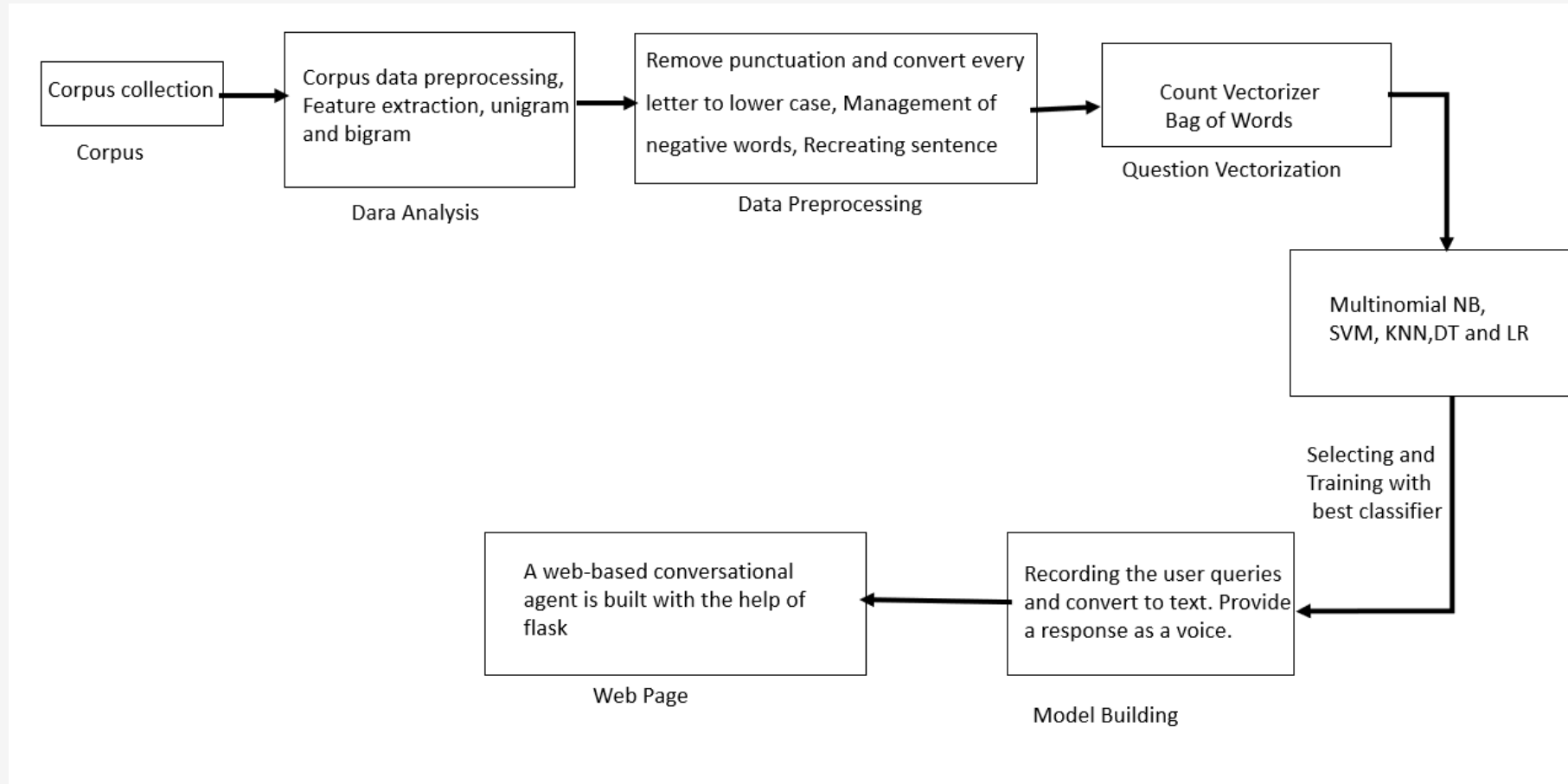
The three objectives of this project is;

1. To develop the corpus for a QA system for a university receptionist.
2. Find the best classifier for conversational agents among algorithms like Multinomial NB, SVM, KNN, Decision tree, and Multinomial LR.
3. Develop a conversational agent using the ML models.



Project Methodology

Conceptual Framework | Research Design



Resource Specifications

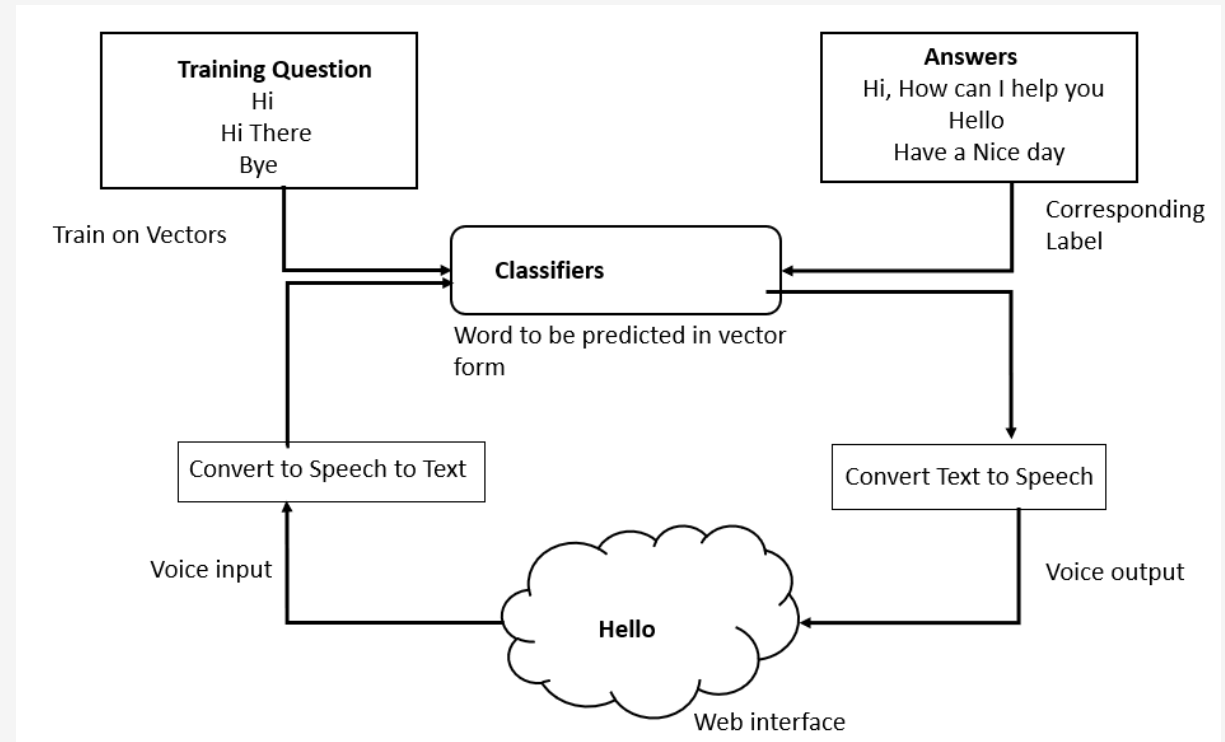
Software | Hardware | Others

- ☐ Joblib
- ☐ Pyttsx3
- ☐ Speech_recognition
- ☐ Microphone usage : PyAudio
- ☐ Flask
 - Rendering Templates
 - Request
 - Redirect

| Software/Hardware requirements | |
|--------------------------------|--|
| OS | windows 7+ |
| Memory | 512MB |
| Storage | 50MB |
| Soundcard | Microphone/Headset required for capturing voice commands |
| CPU | Intel Core2 Duo E8300 @ 2.83GHz or AMD A10 PRO-7800B APU |
| Graphics card | NVIDIA GeForce 510 or AMD Radeon R5 235 |

The suggested model will be required the below inputs:

1. Questions
2. Answers
3. Serial Number (Label)



Dataset

Initially collected around 630 general questions which regularly come to the university front desk and authorities. Then the questions are categorized as Admission, HR, Hostel, ERP support, Academics, Examination, UG courses, Certificate/Diploma/PG Diploma, Ph.D. and RACE.

- ❑ Dataset exploration: Data visualization and statistical methods as the first stage in data analysis to define dataset characterizations, such as size and composition.
- ❑ Extracting features: The frequency of each word and the most common words in the dataset will be converted to a bag of words with the *CountVectorizer*. Split data into training and testing set
- ❑ Initial data processing steps: Remove Punctuations and change all words to lowercase. Anti-spam and anti-hate speech detectors improve the social media experience. All of these attributes rely on n-grams to develop their well-deserved reputation for dependability. When $n=1$ it is a Unigram, and when $n=2$ it is a Bigram.

Determine the optimal classifier

Step 1: Input the corpus:

Step 2: Check for Null values in the corpus

Step 3: Build the following functions to pre-process the question in the corpus.

3.a: Remove punctuation and convert every letter to lowercase

3.b: Management of negative words

3.c: Recreate the sentence

Step 4: Finally assign the newly constructed questions to list, to train the model, along with respective labels and answers.

Step 5: Create a function that will call all the functions created in *Step 3*.

Step 6: Convert questions using *CountVectrozer* to BOW format.

Step 7: Train the vectors using any of the following classifiers: DT, SVM, LR, NB, and KNN.

Step 8: Create a chat utility that interacts with the user until the user presses "quit."

8.a: The bot initiates the chat

8.b: By invoking each of the functions in *step 5*, the user queries will go through pre-processing.

8.c: The chosen classifier in *Step 7* then begins predicting outcomes by giving each response a label.

Step 9: Start the conversational helper program.

Development of conversational agent

Step 1: The Voice bot greets the user and introduces herself.

Step 2: A bot prompts the user to speak and a listen function is enabled

Step 3: The bot is able to understand the user's commands since it listens to them [using the listen function provided earlier].

Step 4: The Listen function transforms the voice of the user to text.

Step 5: Text-based predictions are made with the help of a Multinomial NB classifier.

Step 6: Bot then verbalizes the forecast [using the speak function built above].

Step 7: The Bot will ask the user to repeat themselves if they are unable to speak or are not fully audible. This loop repeats until Bot is able to comprehend the user's words.

Step 8: Bot terminates the communication when a user requests to 'Exit' or 'Quit' the conversation.



BOT

Model is trained with the initial dataset that is 638 questions.
The validation is performed with 305 augmented questions.

```
Hi, I'm a bot,How can i help you?
hi
Hi there
how are you
Good, tell me..
I'm not able to connect to the admission department.
You can write to admissions@reva.edu.in. One of our admission counsellor will contact you at your registered mobile number
What are the courses that are offered?
Computer Applications, Arts and Humanity, Law, Architecture, Management, Certification program
Computer Applications courses are offered in the university.
Bachelor of Computer Applications (BCA)
The arts and humanity courses are offered in the school.
1. BA in Political Science, Economics and Journalism
2. BA in Journalism, English and Psychology
3. BA in Tourism, Journalism and History
4. BA in Journalism and Mass Communication
5. BA in Performing Arts, English, and Psychology
Law courses are offered in the University of Georgia.
1. Bachelor of Arts and Bachelor of Laws (B.A., LL. B. Honours)
2. Bachelor of Business Administration and Bachelor of Law (BBA., LL. B. Honours)
The courses in architecture are offered in the university.
Student will have to select one open elective subject in a semester from any stream.
The architecture courses are offered in the University.
Bachelor of Architecture (B. Arch.)
```

Testing and Validation

Test Results / Learnings

```
127.0.0.1 - - [13/Oct/2022 16:38:59] "POST /chatbot HTTP/1.1" 200 -
user response recording started...
finished recording
user: is the university from airport
BOT: 20 km
user response recording started...
finished recording hh
user: is the application timeline for admission
BOT: The application have varied timelines. For details www.reva.edu.in
user response recording started...
finished recording hh
user: what is a criteria for engineering G
BOT: Passing in PUC / 10+2 examination with Physics and Mathematics as compulsory subjects along with one of the Chemistry / Biotechnology / Biology / Computer Science / Electronics / Technical, Vocational subjects and obtaining at least 45 % marks (40% in case of candidate belongs to SC/ST category) in the above subjects taken together, of any Board recognized by State Governments / Central Government / Union Territories or any other qualification recognized as equivalent thereto. Getting a high score in REVA University Common Entrance Test (REVA CET) or K-CET / COMED-K or any other equivalent examination conducted by recognized Institute / Agency.
user response recording started...
finished recording hh
user: how is the security arrangement in campus
BOT: The University has installed CCTV cameras. Digital screening is mandatory for all visitors who visit the campus. There is 24 hours security provided for all students in campus.
user response recording started...
finished recording hh
user: is there a food court in campus
BOT: There is a modern multi cuisine food Court with comfortable seating capacity and is located in the heart of the campus. The multi cuisine food comprises of a veg south Indian food, Andhra non veg cuisine, Nonveg grill, Veg and Non veg Pizzas, Pan Asian food, Tea, coffee, cold drinks, healthy juices, Pastas, veg and non veg sandwiches, top of the line bakery, mouthwatering chats and Ice-creams.
user response recording started...
finished recording hh
user: what is the minimum score in GRE
BOT: No, admissions from JEE Mains percentile score is not considered.
user response recording started...
finished recording hh
user: pick you test that come to prepare University
BOT: Deloitte
Dell EMC
IBM
Philips
TCS
Berger
Infosys
Amazon
Juspay
Karvy
KPMG
HP
```

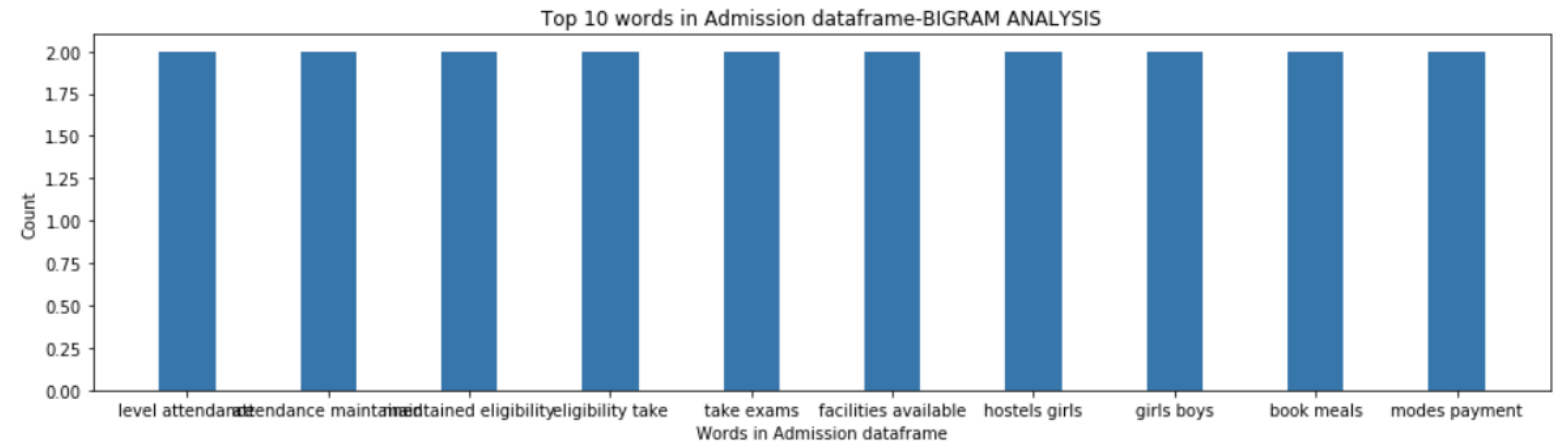
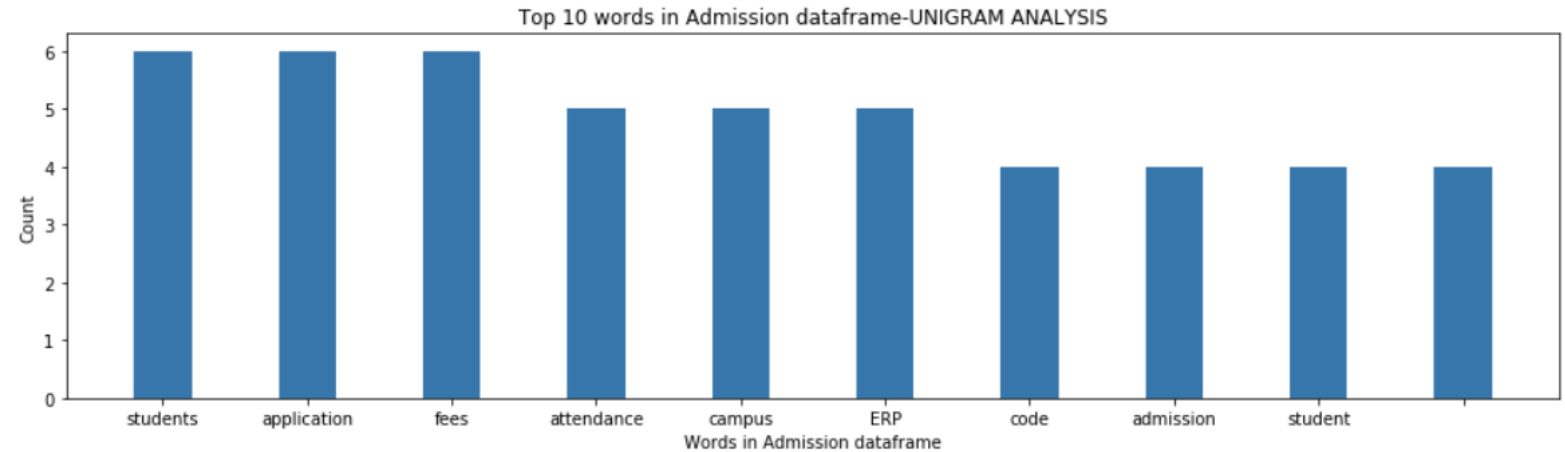
Analysis and Results

Key Findings | Insights

Data analysis.

The N-gram analysis aids in the discovery of relevant keywords.

The results can be used in content strategy development and improvement.



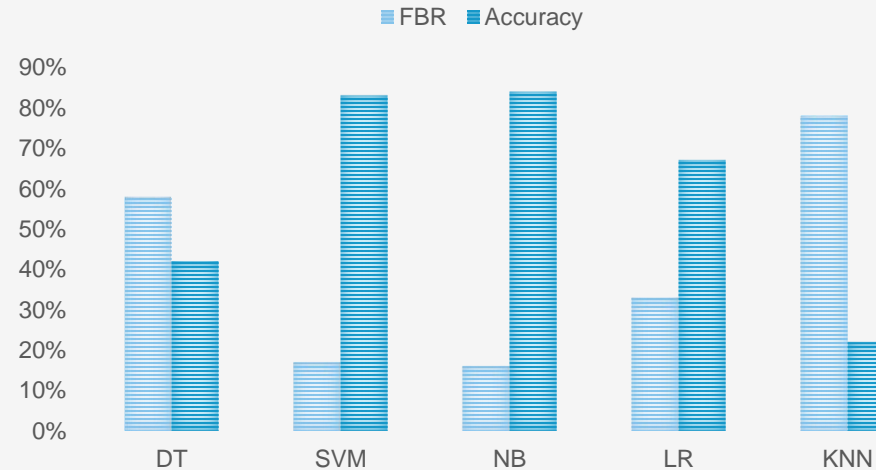
Analysis and Results

Key Findings | Insights

Multinomial NB classifier provides the best accuracy 84 % value and low FBR 16% value than rest of all classifiers.

| Classifiers | DT | SVM | NB | LR | KNN |
|-----------------|-----|-----|-----|-----|-----|
| Correct Answers | 127 | 253 | 255 | 203 | 68 |
| Wrong Answers | 178 | 52 | 50 | 102 | 237 |
| Total | 305 | 305 | 305 | 305 | 305 |
| FBR | 58% | 17% | 16% | 33% | 78% |
| Accuracy | 42% | 83% | 84% | 67% | 22% |

ACCURACY AND FBR



Analysis and Results

Key Findings | Insights

The conversational agent provided an average accuracy of 83%. The accuracy of the proposed solution is significantly impacted by the accents and pronunciations of the individuals.

| Test Engineers | Engg. 1 | Engg. 2 | Engg. 3 | Engg. 4 | Engg. 5 | Engg. 6 | Engg. 7 | Engg. 8 | Engg. 9 | Engg. 10 |
|------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| Correct Answers | 272 | 308 | 288 | 304 | 300 | 296 | 306 | 284 | 303 | 301 |
| Wrong answers | 53 | 17 | 37 | 21 | 25 | 51 | 19 | 41 | 22 | 24 |
| Total | 325 | 325 | 325 | 325 | 325 | 325 | 325 | 325 | 325 | 325 |
| Accuracy | 84% | 95% | 89% | 94% | 92% | 84% | 94% | 87% | 93% | 93% |
| Average accuracy | 83% | | | | | | | | | |

Suggestions and Conclusion

Insights | Next Step | Future Scope

- Artificial Intelligence conversational agents are widespread for web related services for systems like research, showbiz, business organizations, and academic world.
- This project is to develop an interactive conversational agent for university environment using multiple classifiers.
- In future work, conversational agents can mix with ML and Latent Semantic Analysis (LSA). With the help of LSA customers can interact with the conversational agent in real-world human conversation. The dialogue can be improved by adding and altering patterns and templates for general student inquiries using ML and correct replies are given utilizing LSA.

References

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Plagiarism Report¹

An Intelligent Conversation Agent with Multiple Text Classifiers

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