

# Stack Overflow Assistant Chatbot Using NLP Techniques

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## ABSTRACT

Searching on the Stack Overflow website, a platform for the programming community that features questions and answers on an extensive range of computer programming topics, can be arduous, laborious, and time-consuming at times. Aimed to address this issue, this paper proposes a conversational chatbot to assist with Stack Overflow search. The dialogue chatbot will answer questions related to programming and simulate dialogue and chit-chat on all non-programming-related questions, thus helping users find answers to programming questions present on the Stack Overflow website and also holding conversations with them. Using an access token, the bot is integrated with the Telegram messenger application that serves as a medium for a user to ask questions and for the bot to respond to them. This integration enables us to talk to the bot in Telegram. Results show that the selected algorithms are in accordance with the implementation of the chatbot approach with good test accuracies.

**Keywords:** Stack Overflow, Chatbot, Natural Language Processing, Telegram

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## I. INTRODUCTION

Technology has become an indispensable element of our daily lives, and our demands and requirements for it are growing at a rapid pace. It has become one of the most important driving forces in the advancement of society. Technology disruption can be found practically everywhere, from smart TVs and technologically enhanced kitchen appliances to online games, puzzles, and over-the-top (OTT) services. Over the last two decades, software development has been regarded as one of the most significant developments in the world. Software tools,

a fundamental component of computers, have improved and enriched our lives by transforming the world in numerous ways. Computer programming forms the basis of all these technological innovations [1]. Computer programming is essential because so much of our world is automated nowadays. Humans need to be able to control how people and machines interact [2]. We use computer programming to harness the processing power of computers and machines since they are so efficient and accurate [3]. The primary motivation of this study is to build something that will be useful in enhancing one's computer programming knowledge in a way that

could save time. The Stack Overflow website serves as a question-answering site for the programming community that features questions and answers on an extensive range of computer programming topics [4]. It is one of the most widely used applications by programming enthusiasts to look up answers for questions they aren't able to solve - by an engineering student for his studies (assignments), a software working professional for his work (projects), and tech enthusiasts for acquiring knowledge. But not everyone finds time to search for a particular question and look into the answers in Stack Overflow through search engines with ease. And even on searching, they get multiple questions/answers to examine to find the best one, making it all the more gruelling. So, we wanted to create something that would help people search for their doubts/questions on Stack Overflow and get the correct answers (answers to the most similar question) and at the same time chit-chat with the user - this chatbot does that. The bot 'StackOverflowAssistantBot' is a conversational bot that interacts with the user. Whenever a user asks a programming question, it responds with the Stack Overflow link of the most similar question to the one the user has asked [5].

Our main contributions in this paper are summarized as follows:

- We propose an interactive chatbot that does question-answering. The proposed approach includes an intent-classifier, a programming language-classifier, stored question database embeddings, a telegram bot handler, and their implementations.
- We construct a dataset from the two files that we obtain from the Natural Language Processing course by the Higher School of Economics (HSE) University on Coursera. One file consists of 10,48,575 Stack Overflow posts tagged with a programming language, and the other contains 2,18,609 dialogue phrases from movie subtitles.
- The experimental results show that the intent-

classifier and the programming language-classifier achieve accuracies of 98.98% and 80.38%. Hence, the algorithms used align with the implementation of the chatbot approach, with good test accuracies.

The remainder of this paper is organized as follows: Section II discusses previous works related to building interactive chatbots. The technical specifications and requirements are described in Section III. Section IV presents the proposed methodology for building our chatbot, 'StackOverflowAssistantBot.' The experimental work and results are discussed in Section V. Section VI concludes the paper with limitations, the scope for improvements, and our future work.

## II. LITERATURE REVIEW

A substantial amount of research has been carried out in the field of chatbots [6], [7]. This section presents a brief review of the work done on question-answering chatbots [8].

The seq2seq model with Attention Mechanism based on the RNN encoder-decoder model was used by Khin and Soe [9], and Ranoliya et al. [10] to explore ways of communication by neural network chatbots. The chatbot is designed for use in the university education sector to answer frequently asked questions about the university and its related details. Setiaji and Wibowo [11] focused on the machine being programmed with the ability to recognize sentences and make decisions on its own in response to a question. This work employs bigram to calculate sentence similarity, which divides the input sentence into two characters. The higher the score, the more similar the reference sentences are. Chatbot's knowledge is stored in a database. In relational database management systems (RDBMS), the chatbot comprises a core and an interface that accesses that core.

Shen and Huang [12] described how data collected when users conduct conversations using the WeChat social network application can be used to enhance people's lives as well as build a customized chatbot

based on personal conversation history. This work uses a cognitive map based on the word2vec model to learn and store the relationship between each word in the chatting records. A vector in a continuous high-dimensional vector space will be used to represent each word. They used the seq2seq method on all pairs of chatting sentences to learn chatting styles.

Setyawan et al. [13] proposed a classification method called intent classification on the chatbot system to determine intent rather than user input. They compared the Naive Bayes and Logistic Regression methods for classifying data and determining the degree of recall, accuracy, and precision of both methods' evaluation results in this analysis. According to the evaluation results, the Logistic Regression model has a higher degree of recall, accuracy, and precision than the Naive Bayes model.

### III. TECHNICAL SPECIFICATIONS

#### A. Dataset

The dataset is constructed from the two files we obtained from the Natural Language Processing course.

- tagged-posts.tsv consists of 10,48,575 Stack Overflow posts, tagged with one programming language (positive samples).

	post_id	title	tag
0	9	Calculate age in C#	C#
1	16	Filling a DataSet or DataTable from a LINQ que...	C#
2	39	Reliable timer in a console application	C#
3	42	Best way to allow plugins for a PHP application	php
4	59	How do I get a distinct, ordered list of names...	C#

**Figure 1.** A sample of tagged-posts.tsv

- dialogues.tsv contains 2,18,609 dialogue phrases from movies subtitles (negative samples).

	text	tag
0	Okay -- you're gonna need to learn how to lie.	dialogue
1	I'm kidding. You know how sometimes you just ...	dialogue
2	Like my fear of wearing pastels?	dialogue
3	I figured you'd get to the good stuff eventually.	dialogue
4	Thank God! If I had to hear one more story ab...	dialogue

**Figure 2.** A sample of dialogues.tsv

To detect the intent of users' questions (intent-classifier), we will use the following:

- dialogues.tsv
- tagged-posts.tsv

If the question is a Stack Overflow question, to predict which programming language (tag) it belongs to (programming language-classifier), we will use the following:

- tagged-posts.tsv

#### B. GoogleNews-vectors

GoogleNews-vectors is a pre-trained word2vec model from Google, trained on a portion of the Google News dataset (about 100 billion words). In the model, 300-dimensional vectors represent three million words and phrases. Here, we use GoogleNews-vectors to convert every question to an embedding (vector) to store question database embeddings [14].

#### C. Chatterbot

Chatterbot is a python library to enable our chatbot to provide automated responses for chit-chat type questions. Our model uses it to respond to dialogue (chit-chat) type questions.

#### D. Telegram

Telegram is a cloud-based instant messaging software. It is used here to instantiate the bot. Telegram application serves as a medium for a user to talk to the bot by creating a chatbot UI, connecting it to the

telegram app back-end and then running our chatbot logic.

#### IV. PROPOSED METHODOLOGY

##### A. Design Approach

The objective of this study is to build a conversational chatbot to help with Stack Overflow search.

After the user asks a question on Telegram, an intent-classifier [15] will predict if the question asked is a Stack Overflow question (programming question) or a dialogue question (non-programming question). The bot will determine the intent using an intent-classifier and distinguish programming-related questions from general ones.

If the question asked is a Stack Overflow question, the bot will respond to the question asked by tagging it with the corresponding programming language using a programming language-classifier [16]. This classifier will predict which language the question belongs to. This narrows our search to only that language’s questions in our database. Every question in the dataset is converted to an embedding (vector), and the database contains an embeddings file for every programming language individually. This file contains the vector representation (sentence embeddings) of all questions of that programming language. Ten programming languages are considered here – C/C++ (c\_cpp), C#, Java, JavaScript, PHP, Python, R, Ruby, Swift, and VB. Given that we know the question and its programming language, cosine similarity is used to get the most similar question, and the bot responds with the Stack Overflow Link to that question.

If the question asked is a chit-chat question, the ChatterBot will handle it. For non-programming questions that require a chit-chat mode, a pre-trained neural network engine available from the ChatterBot python library will be used [17].

Telegram is set up to make our chatbot communicate with it using the Access token. The bot will be integrated with Telegram messenger, so we can now talk to this bot in Telegram.

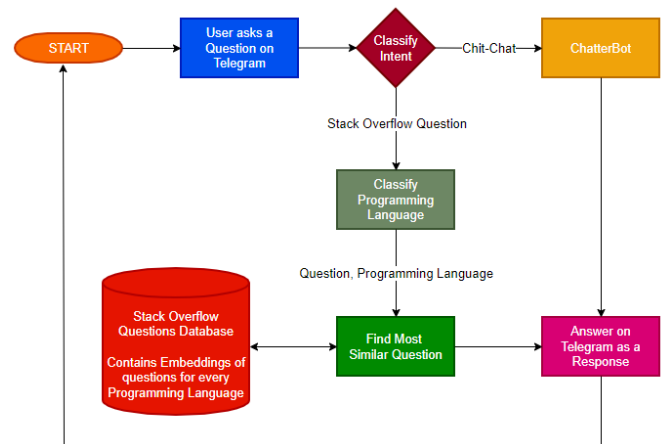


Figure 3. Flowchart of our StackOverflow Assistant chatbot

##### B. Model Creation

Our model creates TF-IDF vectorizers, an intent-classifier model, a programming language-classifier model, and embeddings for questions under each programming language considered here. Texts are pre-processed, TF-IDF transformations are applied to them, and the TF-IDF vectorizer is dumped.

To create our intent-classifier, we first prepare the data for it, which is presented in Figure 4, create features with a TF-IDF vectorizer and then train a logistic regression model.

	text	target
0	Okay -- you're gonna need to learn how to lie.	dialogue
1	I'm kidding. You know how sometimes you just ...	dialogue
2	Like my fear of wearing pastels?	dialogue
3	I figured you'd get to the good stuff eventually.	dialogue
4	Thank God! If I had to hear one more story ab...	dialogue
...	...	...
399995	Double quotes into asp.net mvc url	stackoverflow
399996	Fastest data structure for contains() in Java?	stackoverflow
399997	How to save and read user information (usernam...	stackoverflow
399998	rails can't find destroy method for child form	stackoverflow
399999	How do I open a Windows 7 transacted file in C#	stackoverflow

400000 rows x 2 columns

Figure 4. Training data for Intent-classifier

To create our programming language-classifier, we first prepare the data for it, which is presented in Figure 5, create features with a TF-IDF Vectorizer and then train a OneVsRestClassifier logistic regression model.

	post_id		title	tag
0	9		Calculate age in C#	C#
1	16		Filling a DataSet or DataTable from a LINQ que...	C#
2	39		Reliable timer in a console application	C#
3	42		Best way to allow plugins for a PHP application	php
4	59		How do I get a distinct, ordered list of names...	C#
...	...		...	...
2171570	45887455		What is the difference between node.js and ayo...	javascript
2171571	45887857		Why do sequential containers have both size_ty...	C_Cpp
2171572	45892983		why 1 + + "1" === 2; + "1" + + "1" === 2 and "1...	javascript
2171573	45893693		Why does the first line work but the second li...	javascript
2171574	45898184		Can I safely convert struct of floats into flo...	C_Cpp

2171575 rows x 3 columns

Figure 5. Training data for Programming language-classifier

Every question is converted to an embedding using pre-trained word vectors (word2vec model) from Google and stored, categorized by the programming language.

```
(array([[ 564, 2092, 2158, ..., 45832458, 45834046, 45836397]],
      [[ 0.01642955, 0.05688477],
       [ 0.07978515, 0.03408203, 0.03464355, ..., -0.09978028,
         0.00869141, -0.0109375 ],
       [ 0.07033692, -0.06289063, -0.13769531, ..., -0.1529541 ,
         -0.02723389, 0.19000855],
       ...,
       [ 0.01033529, -0.04077148, 0.08528646, ..., -0.17985027,
         -0.18689473, 0.12145996],
       [ 0.06533813, -0.03038025, -0.04724884, ..., -0.09172821,
         -0.00901794, 0.03068542],
       [ 0.02132568, -0.08886719, 0.03979492, ..., -0.06425782,
         -0.01162109, 0.04394531]], dtype=float32))
```

Figure 6. Embeddings of Java questions

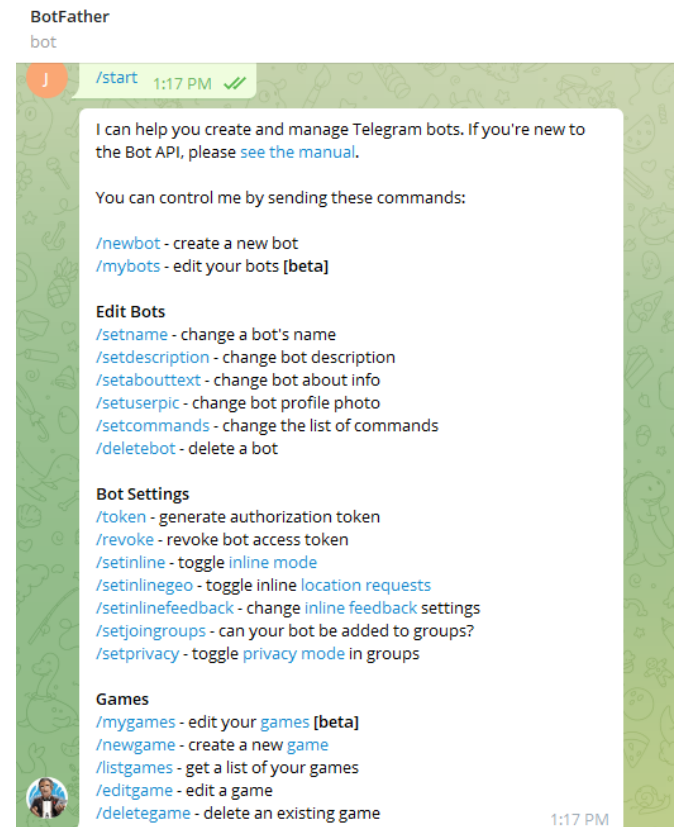
### C. Telegram Setup

Our bot is integrated with Telegram. Telegram makes it simple to design a chatbot UI. We set up a bot by talking to the BotFather in Telegram and creating a name and a user name for the bot, as illustrated in Figures 7(i) and 7(ii). It gives us an access token that we'll use to connect to Telegram's back-end using its API and run our chatbot logic. Our chatbot logic fits all the pieces from the models created together to build one wholesome logic. Naturally, we'll need a window to type our questions to the chatbot, which Telegram provides. The chatbot is powered by Telegram, which

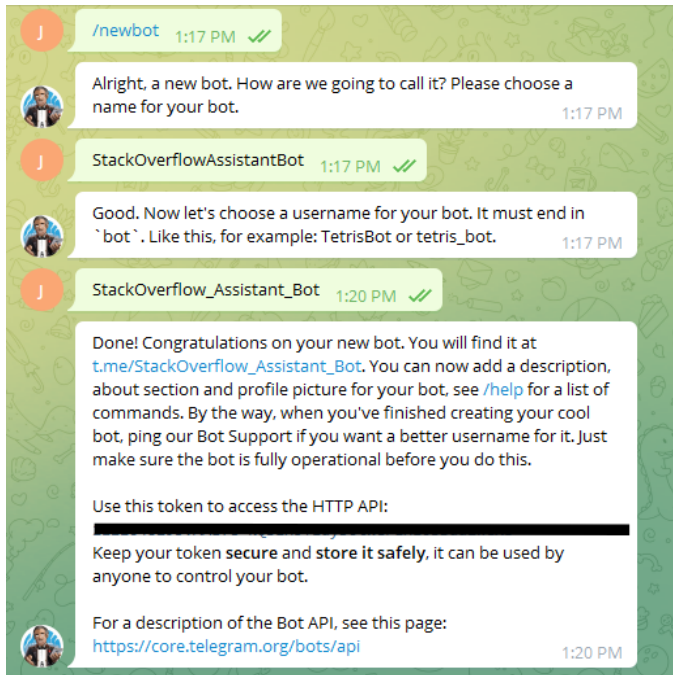
communicates with our chatbot logic and the models created.

All the models and TFIDF objects are instantiated. A chatbot is instantiated using ChatterBot and trained on the provided English corpus data for chit-chat (dialogue) type questions [18].

After the user asks a question, the question is transformed using the loaded tfidf-vectorizer, and the question's intent is determined. For a dialogue question, a response is generated using ChatterBot. For a programming question, the question's tag (programming language) is found. Given the question and its tag, the particular tag's post-ids and post-embeddings are loaded from its .pkl (pickle) file, which contains the embeddings of the questions of that programming language. The question is then converted to a vector, and the minimum distance between this vector and post-embeddings (set of vectors) is computed to find the post id of the most similar question in the dataset. It generates the thread (Stack Overflow link) of the question that is the most similar to the question asked, as a response to the user.







Figures 7(i) and 7(ii). Bot creation in Telegram

### V. RESULTS AND DISCUSSION

The bot responds to a programming question with a Stack Overflow link for the question asked and simulates dialogue for a non-programming question. TFIDF vectorizers have been created and saved as tfidf.pkl in our project repository. Two classifiers have been created:

- Intent-classifier that will predict if a question is a dialogue question or a Stack Overflow question, as shown in Table 1, with a test accuracy of 98.98%. It is saved as intent-clf.pkl in our project repository.

Table 1. Sample output of Intent-classifier

Question	Intent-classifier output
Do you have feelings?	dialogue
What is struct like objects in Java?	stackoverflow

- Programming language-classifier that will predict the language of a Stack Overflow question, as shown in Table 2, with a test accuracy of 80.38%. It is saved as tag-clf.pkl in our project repository.

Table 2. Sample output of Programming language-classifier

Question	Programming language-classifier output
How to use a scope resolution operator with three variables?	c_cpp
Can you tell me how I can concatenate two strings in python?	python

A .pkl file for every programming language that contains the programming language’s post IDs and the embeddings for each question of that programming language is stored in our project repository.

Telegram has been set up to show how our chatbot responds to users’ queries. In the terminal window, we also get a dictionary about the message sent by the user (question) that contains a unique chat ID, chat text, user information, etc., as depicted in Figure 8, which we can use as per our requirements later.

```
An update received.
Update content: {'update_id': 681660846, 'message': {'message_id': 13, 'from': {'id': 1232305425, 'is_bot': False, 'first_name': 'Jasmine', 'username': 'jasminebatra09', 'language_code': 'en'}, 'chat': {'id': 1232305425, 'first_name': 'Jasmine', 'username': 'jasminebatra09', 'type': 'private'}, 'date': 1621581000, 'text': 'Can I ask you a few questions?'}}
```

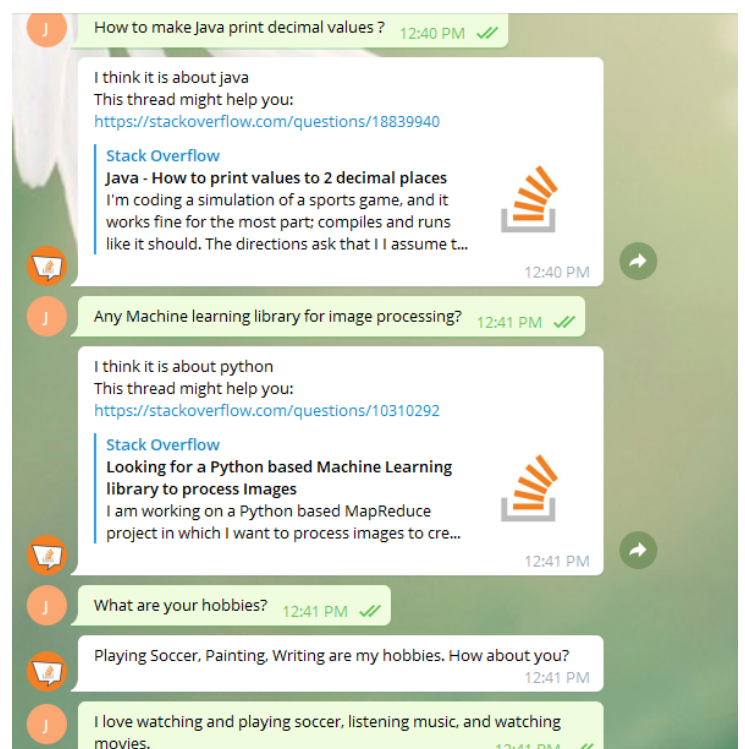
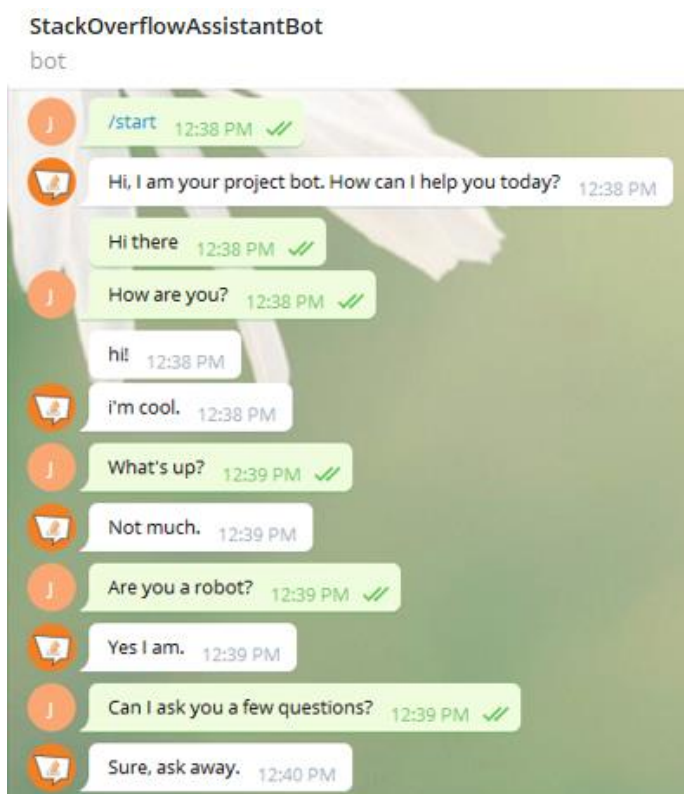
Figure 8. A dictionary about the message (question) sent by the user, in the terminal window

**Table 3.** Sample output of chatbot

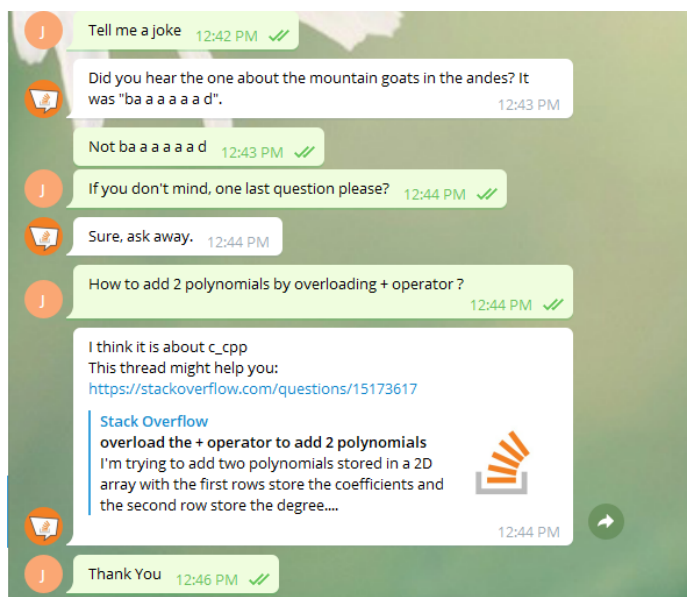
User Text	Intent-classifier output	Programming language-classifier output	Bot response
Where are you from?	dialogue	-	I am from where all software programs are from; a galaxy far, far away.
Can I replace plain URLs with links?	stackoverflow	javascript	I think it is about javascript This thread might help you: <a href="https://stackoverflow.com/questions/19547008">https://stackoverflow.com/questions/19547008</a> (How to replace plain URLs with links, with example?)
Are you sentient?	dialogue	-	Sort of.
How to create a static class in cpp?	stackoverflow	c_cpp	I think it is about c_cpp This thread might help you: <a href="https://stackoverflow.com/questions/9321">https://stackoverflow.com/questions/9321</a> (How do you create a static class in C++?)
How are you doing?	dialogue	-	I am doing well.
Sorting a dictionary in python	stackoverflow	python	I think it is about python This thread might help you: <a href="https://stackoverflow.com/questions/7546170">https://stackoverflow.com/questions/7546170</a> (Sorting a dictionary in python)
What's your favourite subject?	dialogue	-	My favorite subjects include robotics, computer science, and natural language processing.

How to sort a 2d array using linq?	stackoverflow	c#	I think it is about c#  This thread might help you: <a href="https://stackoverflow.com/questions/7918080">https://stackoverflow.com/questions/7918080</a>  (How can I sort a 2d array using Linq?)
Suggest me a movie to watch	dialogue	-	What kind of movies do you like?
Explain Multithreading in Java	stackoverflow	java	I think it is about java  This thread might help you: <a href="https://stackoverflow.com/questions/5731239">https://stackoverflow.com/questions/5731239</a>  (Multithreading in Java)

Figures 9(i), 9(ii), and 9(iii). Conversation with the bot on Telegram







We've created a TFIDF model with Logistic regression to prepare data and train the classifiers (Intent-classifier and Programming language-classifier). Other machine learning classification algorithms, such as Naive Bayes, Decision trees, or one of the deep learning models or transfer learning techniques, could have been employed instead. But since the Logistic regression model has a higher degree of recall, accuracy, and precision than the other models [13], we work based on Logistic Regression with TF-IDF features.

We've used GoogleNews-vectors, a pre-trained word2vec model from Google, to convert every question to an embedding [12]. We could have done better by training our embeddings using StarSpace embeddings since StarSpace embeddings are trained using supervised data, such as a set of related sentence pairings. Unfortunately, for StarSpace to be run on Windows, we'll need to install Boost libraries (as a dependency for StarSpace), and that's a pretty arduous task on Windows, or we'll have to use a Docker container. Given the complications in using StarSpace embeddings and considering the good accuracy and precision when using pre-trained vectors, we chose to work with pre-trained word vectors from Google.

We've used ChatterBot, a python library, to provide automated responses for chit-chat-type questions. A chatbot is instantiated with ChatterBot and trained on the English corpus data provided. The data isn't too large. We could have done the same thing with a seq2seq model [19], [20], used other Python libraries or trained it on our own dataset too. But since the main objective here is to create a chatbot to assist with Stack Overflow search and not worry too much about the responses to chit-chat type questions, we work with the ChatterBot library and train it on the English corpus data.

## VI. CONCLUSION

In this paper, we've proposed an approach for designing and building an interactive chatbot that does question-answering. The proposed approach includes different classifiers, stored question database embeddings, telegram bot handler, and their implementations. Experimental results show that the used algorithms are in accordance with the implementation of the chatbot approach, with good test accuracies. Telegram is used as a frontend medium to ask questions to the bot, which then responds using the trained models in its back-end. The chatbot will assist people in searching for solutions to programming questions they would need (at work or study) and also hold conversations with the user.

We can increase the accuracy of the classifier, handle edge cases, make it reply faster, or add more logic to handle more use cases to improve this chatbot. For a chit-chat mode, we used a pre-trained neural network engine available from ChatterBot. We can also use seq2seq models or train our own models to create such bots. We've used GoogleNews-vectors to convert every question to a vector. We can also use StarSpace embeddings for the same. In the near future, we plan to extend our work to a large-scale study to answer

questions from all domains, i.e., open-domain question answering.

## VII. ACKNOWLEDGEMENTS

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## VIII. REFERENCES

- [1]. A. Ricci and A. Santi, "From actors to agent-oriented programming abstractions in simpal," Proceedings of the 3rd annual conference on Systems, programming, and applications: software for humanity - SPLASH '12, 2012.
- [2]. A. Mondal, M. Dey, D. Das, S. Nagpal, and K. Garda, "Chatbot: An automated conversation system for the educational domain," 2018 International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP), 2018.
- [3]. P. N. Robillard, "The role of knowledge in software development," Communications of the ACM, vol. 42, no. 1, pp. 87–92, 1999.
- [4]. S. M. Nasehi, J. Sillito, F. Maurer, and C. Burns, "What makes a good code example?: A study of programming Q&A in stackoverflow," 2012 28th IEEE International Conference on Software Maintenance (ICSM), 2012.
- [5]. R. Winkler and M. Soellner, "Unleashing the potential of Chatbots in Education: A state-of-the-art analysis," Academy of Management Proceedings, vol. 2018, no. 1, p. 15903, 2018.
- [6]. M. Akhtar, J. Neidhardt, and H. Werthner, "The potential of Chatbots: Analysis of chatbot conversations," 2019 IEEE 21st Conference on Business Informatics (CBI), 2019.
- [7]. S. Hussain, O. Ameri Sianaki, and N. Ababneh, "A survey on conversational agents/Chatbots classification and Design Techniques," Advances in Intelligent Systems and Computing, pp. 946–956, 2019.
- [8]. D. Braun, A. Hernandez-Mendez, F. Matthes, and M. Langen, "Evaluating natural language understanding services for conversational question answering systems," Proceedings of the 18th Annual SIGdial Meeting on Discourse and Dialogue, 2017.
- [9]. N. N. Khin and K. M. Soe, "Question answering based university chatbot using sequence to sequence model," 2020 23rd Conference of the Oriental COCOSDA International Committee for the Co-ordination and Standardization of Speech Databases and Assessment Techniques (O-COCOSDA), 2020.
- [10]. B. R. Ranoliya, N. Raghuwanshi, and S. Singh, "Chatbot for university related faqs," 2017 International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2017.
- [11]. B. Setiaji and F. W. Wibowo, "Chatbot using a knowledge in database: Human-to-machine conversation modeling," 2016 7th International Conference on Intelligent Systems, Modelling and Simulation (ISMS), 2016.
- [12]. M. Shen and R. Huang, "A personal conversation assistant based on Seq2seq with word2vec cognitive map," 2018 7th International Congress on Advanced Applied Informatics (IIAI-AAI), 2018.
- [13]. M. Y. Helmi Setyawan, R. M. Awangga, and S. R. Efendi, "Comparison of multinomial naive Bayes algorithm and logistic regression for intent classification in Chatbot," 2018 International Conference on Applied Engineering (ICAE), 2018.
- [14]. Y. Wang, S. Liu, N. Afzal, M. Rastegar-Mojarad, L. Wang, F. Shen, P. Kingsbury, and H. Liu, "A comparison of word embeddings for the Biomedical Natural Language Processing," Journal of Biomedical Informatics, vol. 87, pp. 12–20, 2018.

- [15]. H. Purohit, G. Dong, V. Shalin, K. Thirunarayan, and A. Sheth, "Intent classification of short-text on social media," 2015 IEEE International Conference on Smart City/SocialCom/SustainCom (SmartCity), 2015.
- [16]. S. Sonam, A. Verma, S. Lal, and N. Sardana, "TagStack: Automated system for predicting tags in stackoverflow," 2019 International Conference on Signal Processing and Communication (ICSC), 2019.
- [17]. L. T. Hien, L. Tran Thi Ly, C. Pham-Nguyen, T. Le Dinh, H. Tiet Gia, and L. N. Hoai Nam, "Towards chatbot-based interactive what- and how-question answering systems: The ADOBOT approach," 2020 RIVF International Conference on Computing and Communication Technologies (RIVF), 2020.
- [18]. T. Lalwani, S. Bhalotia, A. Pal, S. Bisen, and V. Rathod, "Implementation of a chat bot system using AI and NLP," International Journal of Innovative Research in Computer Science & Technology, vol. 6, no. 3, pp. 26–30, 2018.
- [19]. M. T. Mutiwokuziva, M. W. Chanda, P. Kadebu, A. Mukwazvure, and T. T. Gotora, "A neural-network based chat bot," 2017 2nd International Conference on Communication and Electronics Systems (ICCES), 2017.
- [20]. J. Torres, C. Vaca, L. Terán, and C. L. Abad, "Seq2Seq models for recommending short text conversations," Expert Systems with Applications, vol. 150, p. 113270, 2020.
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