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Human Machine Dialogue [145864]
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Final Project Report
03/02/2022

Sexy: The conversational agent that enlightens all your STDs doubts
Final Project Report

1. Introduction

Sexually transmitted diseases (STDs) are common thoughout the world. They can be dangerous if they are not diagnosed and treated. They can also be prevented. (CDC, 2022). But the existence of stds can be a danger not only to physical health, also to mental health. As Emily Nagoski defends in her book “Come as You Are”, there is a cultural message that women encounter in modern America regarding sex being dangerous. The fear of stds interferes negatively in pleasure during sex. Both these issues can benefit significantly with the spread of information. Therefore, the development of a question-answering chatbot about stds seemed ideal for this project.

1.1 Model type

The model type is question-answering.

1.2 Domain

This conversational agent intends to answer questions about STDs (sexually transmitted diseases). It covers 8 diseases: bacterial vaginosis, chlamydia, genital herpes, gonorrhea, HPV infection, pelvic inflammatory disease, syphilis and trichomoniasis. It also recognizes AIDs/HIV, Hepatitis and Chancroid, replying with a source for information on these last ones. To each of the infections present in the database, it can answer questions regarding definition, transmission, prevention, symptoms, treatment, diagnosis and possible health consequences. It can also answer these questions for stds in general. Also, it can answer its scope, the source of the data and give testing recommendations.
Its chitchat capacity is limited to responding to a greeting, a farewell, an expression of gratitude, handling an insult, a lost user without a clear intent, an out of scope question and an unseen intent.
It understands affirmations, denials, expressions of amusement, expressions of questions, stimulus for the bot to lead the conversation, and a request to set the scope for answers to stds in general.

1.3 User Group

Target users of the system are English speakers, especially adults and teenagers, between the ages of 14-30.

2. Conversation Design

2.1 Interaction Properties

2.1.1 Initiatives

The system has two main flows that depend on bot initiative. In case the person does not interrupt or asks questions, the bot will lead the conversation through three topics. When there is not a specific std that the person requested information on, the topics are the definition of sexually transmitted

infections, their prevention and testing recommendations. If the person requests a specific std, the topics would be its definition, transmission and prevention. It is always possible to stop the flow to ask questions. If the person followed at least one turn of the original flow, a mixed initiative scenario occurs, as the bot will try to return to the flow from there. It is also possible for the conversation to be based entirely on the person's initiative. The bot waits for their first message, then to their reply after introducing itself and before starting to lead the conversation.

2.1.2 Acknowledgement

Every message of the user is followed by a response from the bot. When there is a clear intent that belongs to the bot's scope, the adequate answer is provided. Otherwise, the bot asks the individual to rephrase or send him a link for more information. If the message has a known intent but it is not a question, the bot responds to it and in some occasions asks if the person has any questions. Therefore, acknowledgement is always provided.

2.1.3 Ground-taking

Ground-taking is always led by the bot, as it is either talking or waiting eternally for the person's message. The bot's turn is usually composed by one message containing the content and a following message representing a question to know if it should continue. If the person denies, the bot asks if they have any questions. If they deny again, the bot closes the conversation.

2.1.4 Fall-back Responses

If the message is sufficiently different from all examples of utterances, it is classified as NLU fallback. The bot replies by asking the person to rephrase it. There is also some training data classified with intent *out of scope*, which would cause the bot to reply with a source for more information.

2.1.5 Error Recovery

After errors occur, the bot will go back to the original flow. In case the flow has already been finished or never properly started, the bot should ideally ask the user if they have any questions, and conclude the interaction. However, this feature is still quite unpredictable.

3. Data Description & Analysis

3.1 Dialogue Data

3.1.1 Collection and Generation

There are no response examples, thus a unique message to each of the 36 responses. The responses for technical questions were retrieved from the CDC website. Non-technical responses were generated by me.

3.1.2 Data Analysis

Most of the dialogue training is implemented by rules. There are 19 rules that handle all questions, nlu fallback, insults, greetings and requests. There are also 7 stories that cover the flows in which the bot follows the defined script, handling interruptions, thanking interactions and announcements of questions.

3.2 NLU data

The NLU Data is composed by a group of intents, associated with utterances and synonyms to four of the diseases.

3.2.1 Collection and generation of data

All synonyms and most of the utterances for the intents were generated by me.
Around 10-20 examples were generated for each intent at first. As I tested the system, I noticed errors and enhanced it by adding more intents or utterances for the existing intents. During development, I also asked friends to test the system and included their misunderstood messages to the training data.

3.2.2 Complete Data Analysis

There is an average of 10 turns, if not interrupted. A couple of turns is added every time the person expresses gratitude, asks a question, greets or insults. There are no slots. There is 1 distinct entity with 11 possible values which can be recognized in different forms, corrected and capitalized. There are 5 synonyms.There are 92 entity examples. There are 23 intents and 461 examples of intents in total.

3.3 Domain data

The domain data is composed by a database and a group of responses.
The database is a csv file that contains the names, definition, transmission, prevention, diagnosis, symptoms, treatment and possible health consequences of 8 sexually transmitted diseases: bacterial vaginosis, chlamydia, genital herpes, gonorrhea, HPV Infection, pelvic inflammatory disease, syphilis and trichomoniasis. It has a vocabulary of 757 words and a size of 4974 words.
The technical responses that are not in the database refer to these same topics, but directed to stds in general. This group of responses, including the answers to questions about scope and source of information, has a vocabulary of 307 words and a size of 1065 words.

4. Conversation Model

4.1 Model/Algorithm

The algorithm is composed as a rasa-based system.

4.2 Response policy

Response policy was slightly adapted from Rasa's default example. It is composed by Memoization Policy, RulePolicy, with threshold for fallback 0.3. Followed by UnexpecTEDIntentPolicy and TEDPolicy, both with maximum history 5 and 100 epochs.

4.3 Fallback policy

The fallback policy is achieved with the FallbackClassifier, which uses threshold 0.7 and ambiguity threshold 0.1. Therefore, any message that is classified by system as a certain intent with confidence below 0.7 is classified as NLU fallback. The bot's response is a request for rephrasing.

4.4 Vocal model

There is no vocal model

4.5 NLU model

The pipeline is composed by a WhitespaceTokenizer, a RegexFeaturizer, a LexicalSyntacticFeaturizer, a CountVectorsFeaturizer, a DIETClassifier, an EntitySynonymMapper, a ResponseSelector and a FallbackClassifier.

5. Evaluation

5.1 Results

5.1.1 Natural Language Understanding

Statistics for Entity Extraction - Name of the Sexually Transmitted Disease (STD_name)	
Precision	0.92
Recall	0.95
F1-score	0.93

The results of the classification of intents are too extensive for this report. The confusion matrix can be found in the Appendix section, located at the end.

5.1.2 Dialogue Management components

Content responses were considered too long from one of the volunteers and myself. The fallback policy and error recovery exchanges usually are satisfactory. More errors were noticed when the dialogue becomes too long. The bot sometimes repeats responses. But it is always capable of answering questions when a clear intent is identified, providing task completion every time.

5.2 Interpretation of errors and analysis

Several of the intents were confused between one another, especially when some of the training examples of multiple intents repeated the same words. This is also due to the multiple intents the user might put in a single message. For instance “yes, thanks” includes intents *affirm* and *thank.*

6. Conclusion

The collection of the domain data has been the greatest challenge towards achieving all goals of this project. Quality of information is crucial in educational initiatives. This aspect is fundamental regarding the goal of spreading correct and complete information on stds, and in helping to take down the fear upon them. However, these two ambitions are not jointly pursued in health agencies such as CDC. The consequence is that many answers are not very reassuring, and might increase worriedness along with decreasing infections. It would be necessary to rephrase or reformulate many of the pieces of information I collected in the CDC website, which might be problematic as well.

Another challenge is that a portion of the volunteers who tested the system showed discomfort around the theme. This aspect makes it harder to collect training data from real conversations. However, it also evidentiates how relevant a chatbot designed for these purposes would be. These individuals could be more stimulated to inform themselves, if they could do it without the presence of others.

Finally, dialogues are complex. Several intents can have examples that are very close, depending on word order to establish the semantics. Several utterances might also include multiple intents. The system could be improved by covering these complex interactions gracefully, lowering error rates. A possible future step is to increase the number of intents, responses, stories and training data, being also careful to not overfit. But this also means an ever-larger dynamic project, as is language.

7. References

NAGOSKI, Emily. *Come as you are: The surprising new science that will transform your sex life*. Simon and Schuster, 2015.

Centers for Disease Control and Prevention (CDC). (2022). *Sexually Transmitted Diseases - Information from CDC*. Retrieved January 25, 2022, from https://www.cdc.gov/std/

8. Appendix