MentFit: A Mental Health Chatbot Using Deep Neural Networks

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***Abstract*—In today's generation, mental health plays a major role in one's life. Mental Health and Physical Health are equally important. Atleast 1 in 5 adults experience a mental health concern. With this in mind, the main objective of this paper is to create a chatbot that not only helps you in understanding the basic psychological terms but also helps you process your thoughts and emotions better. Using the dataset, that has all possible emotions, for example, depression, anxiety, happiness, scared, etc, categorized, then applying the concept of deep neural networks and Stochastic gradient descent with Nesterov accelerated gradient to get the most probabilistic response depending on the input of the user.**

***Index Terms*—Chatbot, Mental Health, Deep Neural Network, Stochastic gradient descent**

I. Introduction

Just like physical health, mental health also plays a vital role in determining the lifestyle of an individual. A healthy mind is crucial towards leading a healthy lifestyle. But unfortunately, due to lack of proper awareness and social stigma, mental health is not given the importance it deserves [4]. Mental disorders affect 29 percent of the global population. Every year, 25 percent of adults and 10 percent of children are affected. The most common mental disorders are depressive disorders and anxiety disorders. In 2017, 322 million people suffered from depressive disorders and 264 million from anxiety disorders worldwide [5].

As the coronavirus pandemic hastily sweeps across the world, the consequential economic recession has negatively affected many people's mental health and shaped new barriers for people already suffering from mental illness. Depression alone marks more than 264 million people according to the WHO. The World Health Organization also reports that between 2012 and 2030, India will experience economic losses of a whopping 1.03 trillion dollars from mental health conditions (Birla, 2019). In a time when physical meetings are becoming occasional, a need for a virtual assistant to comfort people and avail aid in case of adverse situations is felt. Due to attached stigma to mental health issues people hesitate to reach out and avail help. There is a significant gap in the treatment that should be available conveniently and cost-effectively, and the services available at hand. The ratio of therapists, psychiatrists, psychiatric social workers and mental health nurses to patients is 1: 10,000, even in developed countries [3].

A poor mental health hinders the daily effectiveness of an individual and at times are accompanied by hypertension, heart disease, suicidal intentions, etc. Hence, it is really important to maintain mental health as it is to maintain physical health in the modern era. In this project, we aim to build a chatbot that acts as a platform to solve the problem discussed [4].

Chatbots are software applications which help in simulating human like conversations through voice commands or text-based chats or both. Its, a service backed by rules and in some cases Artificial Intelligence which converses with the customer through different platforms of communication. Chatbots constantly require training and testing to fit with the ideal standards set by the developers [1].

While a chatbot cannot replace a human therapist entirely, it can provide a platform for individuals to let out their emotions and get moral support whenever they feel distressed. The motivation behind this project is that there are several situations wherein a person feels the need to talk to someone and share his/her feelings but cannot do so due to various reasons like lack of time, personal issues, non-availability of a listener, etc. Most of them are reluctant to go through therapy due to social or monetary obligations. We intend to make a chatbot which will be easy to chat with and available 24x7, so that the user can share their emotions when they feel stressed out or worried, which will help them improve their mood [4].

II. Related Work

Due to the corona virus pandemic, many researchers have tried to implement the same idea but there were a few drawbacks, as follows,

1) No memory of past conversations - leading to every interaction with the chatbot, being fresh.

2) Synthesized messages were of poor quality, and most messages generated are the on extremes or neutral.

3) The input data was generalized, leading to the chatbots working more as Question-Answer agents rather than health-care agents.

III. Implementation

A. Data Collection

The data is partly self-curated. We started off with a publicly available list of 100 questions and answers related to mental

health. Later, we scraped data on health related questions and their answers. We ordered this into a JSON file consisting of tags, patterns and responses. Finally, more than 3,500 JSON elements present.

Tags are the unique class labels which will be used for classifying new sentences.

Patterns are going to be used to match the user input with. If there's a high similarity match in the pattern and the input(or in our case, the embeddings of the sentences matches the pattern embeddings) then the input text is classified with the corresponding tag.

Finally, responses are a list of replies corresponding to each tag. One reply is chosen at random from the responses to make the chatbot appear like it generates new responses and is not monotonous.

B. Pre-processing

Initially,the sentence is tokenized. Upon tokenization, the words are now put into a list and are also appended to a list of documents(To perform Term frequency - Inverse term frequency analysis). A unique set of classes is also prepared from the tags. In order to combine words such as health, healthy etc into one word, we use Lemmatization. Upon sorting the words and unique tags, we store them in pickle files for loading during training and testing.

C. Model Architecture

We have opted to use a Sequential layer based model - consisting of 3 hidden layers and 3 dropout layers, along with a Stochastic Gradient Descent optimizer with Nesterov gradient. The loss function chosen is 'Catergorical Cross Entropy' as it's a multi-label classification task.

D. Training

The activation functions for the inner layers is the Rectified Linear Unit, while Softmax is used in the Output layer. Hyperparameter tuning resulted in the final model having a learning rate of 0.01, decay of 1e-6 and a momentum of 0.9.The first layer has 256 neurons, second has 128 neurons, third has 64 neurons and the final output layer has the same number of neurons as the number of unique tags.We ran the training for 1500 epochs with a batch size of 64. On a normal CPU-based system it should approximately take 20 minutes to run - making it ideal to play around with. Upon completion, the model is saved in a hist file.

Results of training :

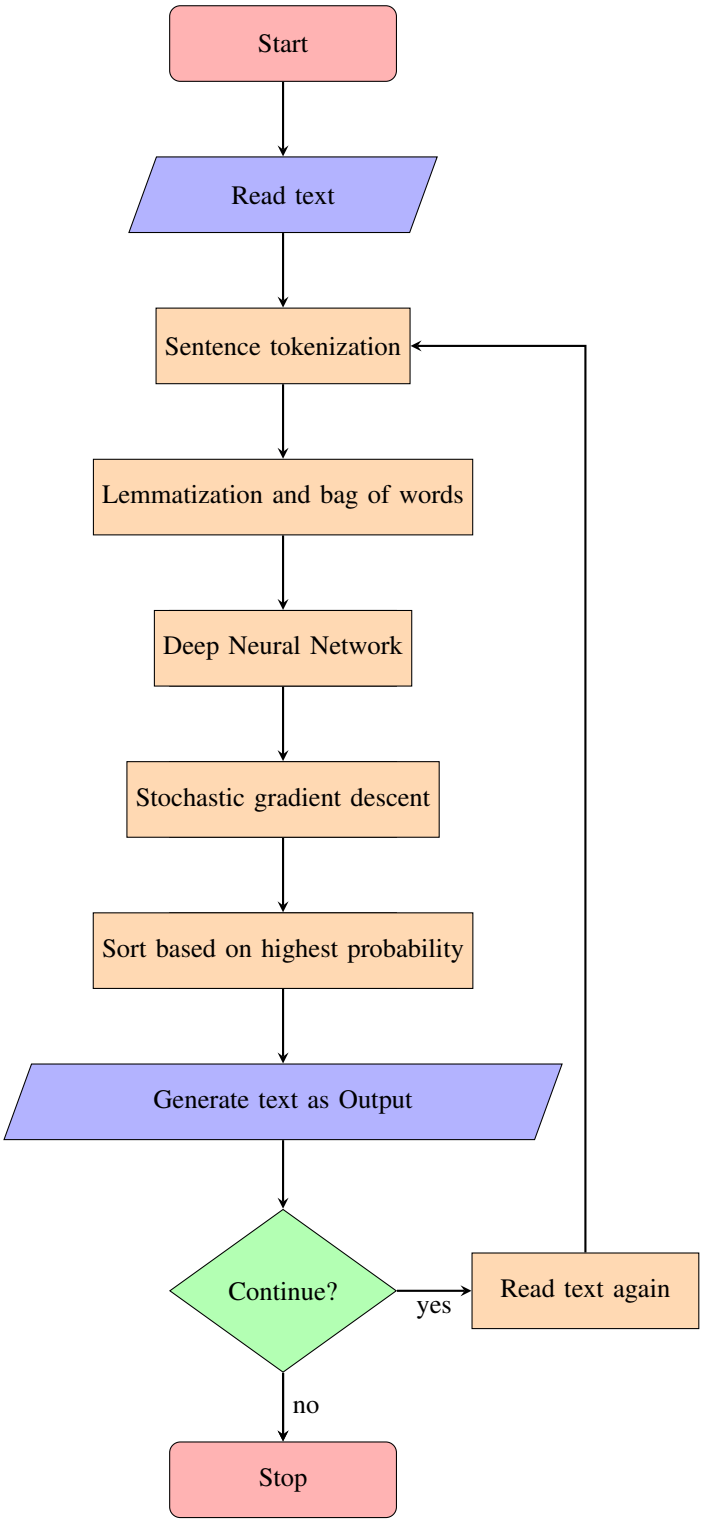
1) Accuracy : 88.23%

2) Loss : 0.2891

E. Testing

The testing of the model comprises of taking user input and running it through our model. Before we can do this, we need to perform some transformations in order to pass it to the model.

Initially, we display a message greeting the user and prompting them to enter a query. The query is tokenized and



lemmatized. Then this resulting input is converted to a bag of words against the set of words we had prepared in the data pre processing phase.The model uses this form of the input to predict a list of tags it matches. The list is sorted with the tags having highest probability in decreasing order. Apart from this, to tackle the problem of ambiguous statements - and erroneous statements - we also have put a threshold probability that must be exceeded for the tag to appear in the list of predictions. The

response is randomly picked from the set of replies present in the highest probability tag's responses. With sufficient testing, we have concluded that the model performs satisfactorily. A few improvements in the processing of the data at the early stage can make the system better at handling similar sentences.

IV. Conclusion

This project serves the primary goal of creating and implementing a chatbot which lets users communicate their feelings and emotions to help them cope up with their daily struggles. The created model exceeds our expectations by giving an accuracy of 88.23%. The future scope would be to implement the model with a better and bigger dataset relevant to mental well-being rather than generalizing it. Exploring the possibilities of using a pre-trained model for data augmentation or enhancing the methods of generating embeddings that will be passed into the model can also be looked at.

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