

# Therapize - A Therapy Chatbot - Extended Review

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## Abstract

*This report will discuss some of the famous chatbots used for psychiatrist usage, with their own ways of programming. We would also be discussing some state-of-the-art algorithms on how they approach the chatbot implementation, the technological tools that have helped them flourish and what specific patterns were used to implement these chatbots. The report contains the extensive results from experimenting with both models. It concludes with the learning curve from the coursework.*

**Keywords:** Machine Learning, Natural Language Processing, Therapy Chatbot

## I. INTRODUCTION

Chatbots have the power to automate activities that people frequently perform in their daily lives. It provides users with ease of use, time-effective service, and proactive customer interaction.

Artificial Intelligence, Machine Learning and Natural Language Processing are the trifectas that make these Intelligent Agents come to life. The best of such agents, i.e. Siri, Google Assistant, and Alexa, stimulate our brains to recognise, perceive and judge.

We would further discuss how people combined the idea of chatbots to get therapy and even experiment with the human psyche.

## II. CHATBOTS IN THE PAST

### i. Eliza

The world's first chatbot got everyone's attention to the idea of a chatbot. Since the Rogerian Psychoanalyst invented Eliza, he had developed a relatively simple framework for the chatbot but still managed to easily manipulate people. The fundamental trick involved in Eliza is trying to mimic a psychologist, and the easiest way for him to do it was

by knowing how to flip the sentence around to ask a digging question that the user finds intriguing. Hitting the users with a twisted question as a response using words of their statements causes the vulnerable person to fall prey to believing the chatbot's responses. Eliza managed to fool people by the simulation of intelligence and rather intelligence itself, [[Deep Learning Based Chatbot Models, 2017]] Weizenbaum coined this delusional pattern of attachment with the machine, the Eliza Effect. This pattern of attachment with the digital machines and delusion thinking started with Eliza, and the list still goes on with numerous inventions of digital agents.

Eliza broke the trend for always using the fanciest algorithms to solve problems. Below is my interaction with Eliza for the first time in Figure[1]

```
ELIZA: How do you do. Please tell me your problem.  
YOU: Who are you  
ELIZA: What if I were ?  
YOU: What do you mean  
ELIZA: What are your feelings now ?  
YOU: Oh, you are good at this.  
ELIZA: Do you sometimes wish you were good at this ?  
YOU: Haha, that's impressive.  
ELIZA: That is interesting. Please continue.  
YOU: █
```

Figure 1: Conversation with Eliza

## ii. Parry

Mimicking a paranoid individual's patterns of belief and thought process, Parry made its way into the natural language processing world. It's built on the very nihilist thought that no people are up for good, all the set of insecurities and complexes to be there in a person creating parry.

A particular Turing Test was developed to judge parry on its capability to mimic human behaviour. Many critics posed Parry for not using any grammar to process its inputs. The whole purpose of Parry was to have its own version of how a paranoid person would be in the real world, which turned out to be quite realistic and did use some advanced algorithms. Unlike any other natural language processing chatbot, the goal was never to go into the depth of linguistic complexity but instead just to throw out responses that convince people to believe that he's a person with schizophrenia who's gone crazy.

Colby [[Kenneth Mark Colby, 1974]] for Parry believed that using an intelligent agent is a much better way of studying any disease than having a patient. It's a close implication to saying that a machine is closer to being the epitome of a paranoid schizophrenia patient than a human will ever be in this lifetime. Following is the interaction between when Joseph Weizenbaum's Eliza met her nemesis, Parry, given below in Figure [2]

ELIZA: Good Evening. Tell me your problems.  
a question mark.  
PARRY: People get on my nerves sometimes.  
ELIZA: I am not sure I understand you fully.  
PARRY: You should pay more attention.  
ELIZA: Suppose you should pay more attention  
PARRY: You're entitled to your own opinion.

**Figure 2:** Eliza meets Parry

## iii. Cleverbot

After the launch of Eliza, countless hand-coded and rule-based chatbots have been released, and a lot of them use the primary dialogue agent that has hand-written rules to generate replies.

They still give out an impressive performance and have convincing power to prove their genuinity. If not Tested rigorously on the questions, it would just seem like an expert bot. Following is my conversation with Cleverbot given in figure [3]



Hey bot.

**But I'm not a bot.**

What makes you think that you're not a bot?

**Because I am.**

What?

**Human.** share!

say to cleverbot...

**Figure 3:** Conversation with Cleverbot

## iv. Eugene

Another machine that was trained to mimic human behaviour and make everyone wonder about the golden question is, 'if machines can think?', investigating if we can in some way pour our consciousness into machines soon. Eugene, i.e. an agent simulating to be a 13-year-old Ukrainian boy, was developed by Vladimir Veselov.

The latter did not believe in Turing Test as a good benchmark for testing Intelligent Agents.

Eugene then turned out to be the only chatbot that we have seen until now that has passed the Turing Test.

### III. DEVELOPMENT OF CHATBOTS

#### i. Bag Of Words

Most bag words approach to developing a chatbot involves the initial preprocessing process using natural language processing. It is to bring the data into a quality format that can benefit the model in the future stages. A bag of words on its own is a way of extracting features from the corpus of data to predict all sorts of sentiments possible within the data.

The way we implemented this model was right about the same process in collecting the bag of words for all tokenised words in the corpus and predicting the sentiment to which it belongs in the dataset. In a live setting, this process takes place to check the input from the user for such sentiments as 'tags' to generate a meaningful response.

#### ii. Word2Vec

The bag of words approach tends to have a constant limitation in adding words into the vocabulary if it's trained on a small corpus of data. Whereas, The goal [[Lu Zhiqiang, 2009]] of the Word2Vec algorithm is to use a neural network to find degrees of similarity between words, enabling us to get semantic and syntactic patterns while we do arithmetic operations on vectors.

Patterns such as vector ("Delhi") – vector("India") + vector ("UK") would give out a vector symbolising "London", such operations can be performed as all the words are encoded into a much higher-dimensional space. The word2vec simplifies in trying to achieve the similarity between words.

There are two models used in training the Word2Vec Model,

- Continuous bag of words (CBOW)
- Continuous skip-gram model.

##### ii.1 CBOW

Syntactic connections are learnt much better between words while using the CBOW approach. It is prepared to foresee a single word from a window size of context words that is fixed. CBOW would retrieve 'feline' as plurals, i.e. 'felines'. The CBOW proves to be faster than the Skip-Gram and, on the contrary, represents words that are more in the count.

##### ii.2 Skip-gram

Skip-gram would consider words that are semantically relevant like 'shirt' is much closer to 'jacket', more on the morphologically different words, according to the paper, [[Alec Radford, 2018]] skip-gram tend to work better with small sizes of datasets, and it can better vectorise the words when the frequency for words are not quite a lot.

#### iii. GloVe Model

Quite similar to the word2vec algorithm, the fundamental thought behind the GloVe word embedding is to infer a relationship for words from a mathematical approach,

The gloVe is a global vector for word representation, the same as being an unsupervised algorithm like word2vec. It's developed to build word embeddings by combining a global word-word cooccurrence matrix from a corpus of data. Embedding results in the vector space display some interesting linear substructures. A better understanding of the word for the similarity index means greater chances of generating the correct response.

#### iv. Generative Pre-Trained Transformer 3 (GPT3)

The GPT-3 model [[Tomas Mikolov, 2013] can also quickly adapt to new words introduced to its vocabulary. GPT-3 is also pretty fantastic at unsupervised machine translation. It's not by performing millions of actions or training sequences to learn a sure thing, it's through scaling up by plain brute force. Maximising the number of million parameters, adjust the weights so well that it can retrieve the knowledge to a remarkable level.

It comes as a giant leap in the technological aspect for chat-bots and Q/A intelligent agents for its tremendous amounts of knowledge. The major limitation coming to GPT-3 would be that it tends to over-fit with its weights and does not always work as a human psyche to ‘improve’ as we go through.

#### v. Seq2Seq With Attention Mechanism

The Sequence to Sequence model with Attention (seq2seq) comprises two RNNs or LSTMs—an encoder and a decoder, as shown in Figure [4][Hung-yi Lee].

The input sequence passed through the encoder is read-only to produce the context vector that would have a semantic summary of whatever the input consisted of in the sequence. The decoder generates the output sequence one word at a time. It has the context vector in check to avoid losing memory and time and focusing on the contextually related words in the sequence.

The attention mechanism [Purushothaman Srikanth] also helps the LSTMs to solve their vanishing gradient problem.

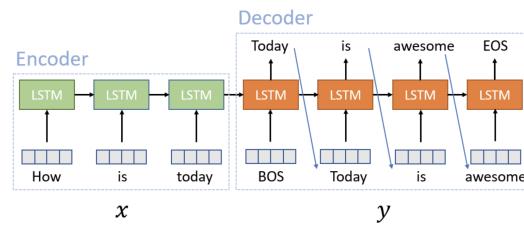


Figure 4: Seq2Seq Model with LSTMs

## IV. EXPERIMENTS

#### i. Bag Of Approach

Experiment with mixing patterns from two different tags or keywords. It strangely worked with one keyword overpowering the other for a long sequence, not with keywords from two tags that are small in size like hey and goodbye as shown in Figure [5].

```
You: hey what is anxiety
Therapize: Everyone has feelings of anxiety at some point in their life. For example, you may feel worried and anxious about sitting an exam, or having a medical test or job interview. During times like these, being anxious is completely normal, but for some people it's difficult to come out of that state, it takes them weeks or months to feeling relaxed again. They lose control over such worries and it starts to affect their daily lives, that's when you should see a doctor. Try to talk to your loved ones and seek help from a certified doctor
```

```
You: You: hey goodbye
Therapize: Sorry, we didn't understand that
```

Figure 5: Response generated by Therapize

In order to optimise misspelt errors [6] and slang, proper cleaning is required. Stemming did not work so well. It is cruder in its chop. Lemmatisation should be a preference for chat-bots as it has its vocabulary and a more defined way of getting to the root word.

```
Hey, Welcome to Therapize. Let's chat! (type 'quit' to exit)
You: hell
Therapize: Sorry, we didn't understand that
You: Hello
Therapize: Hi there, how can I help? :)
You: i too
Therapize: Sorry, we didn't understand that
You: bye
Therapize: Have a nice day :)
```

```
You: bye
Therapize: Sorry, we didn't understand that
```

Figure 6: Interaction with Therapize

#### ii. GPT2 Fine-Tuned

The temperature hyper-parameter for GPT-2 while fine-tuning sets out how crazy of a response we want from the chat-bot.

Low temperature values tend to send a more grammatically correct responses as shown in

Figure [7, it's more specific to the question asked and in a way over-fitted.

```
(YOU) : i really need to get on some medication
(BOT) : hello , and thank you for your question . my first , i like that you have a well - grounded , professional , calm , and non -
YOU : i am not feeling well
(BOT) : is life all about suffering
(YOU) : life is suffering for many people . it sounds like you have a lot of emotions that you are dealing with in a very clinical and
YOU : i have been in pain for all my life
(BOT) : i am pretty sure you are referring to pain symptoms . it ' s caused by the serotonin reuptake inhibitors (ssi ) in the brain
YOU :
```

**Figure 7:** Response recorded on low temperature

High temperature values tend to send a more esoteric answer [8] and not the usual responses that the bot generates. It generalizes well.

```
You : is life all about suffering
(YOU) : is life all about suffering
(BOT) : life is about suffering is often misunderstood , though it is true that there are some aspects of life that are unbearable
(YOU) : can i get some medication over the counter
(BOT) : medications can be effective treatments for depression and they are usually prescribed by a nurse practitioner . the medicat
YOU :
```

**Figure 8:** Response recorded on high temperature

## V. CONCLUSION

Whilst the entire process of developing a chatbot, The learnings were about: preprocessing in any of the NLP models to be the backbone, not using any end-to-end models if there's no large corpus in hand.

In the coursework, the GPT-2 (124M) turned out to be a much better model as it was Pre-Trained on a substantial corpus, and fine-tuning it on the therapy dataset made it more robust for our case. There's also a possibility of doing a zero-shot learning with GPT-2 on the data that was prepared for the coursework.

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