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Using Human Learning to Enhance Machine Learning

Asst. Prof. Divya Jatain, Asst. Prof. Anju Dhillon
Department of Computer Science and Engineering,
Maharaja Surajmal Institute of Technology,
Janakpuri, New Delhi-110058, India,
divyajatain@msit.in, anju.dhillon@msit.in

Abstract- Artificial Intelligence and Machine Learning have always tried to imitate the human way of thinking and problem solving in a better & efficient way. Machine Learning has essentially been different from Human Learning in a sense that Human Learning has always focused on the and Why of a problem whereas, Machine Learning has focused on What. Keeping this fact in mind, in the current work, the authors have developed a framework for a chatbot that uses human learning to enhance machine learning. The model is implemented using the Tensor Flow library in python and the user interactions for the chatbot are provided using web development languages like HTML, CSS, and JavaScript. The model provides as accuracy of around 83% for the given dataset, and trains the machine learning model in a more human-like manner.

Keywords- Chatbot, Neural networks, Deep learning, Natural Language Processing, Human Learning, Keras.

I. INTRODUCTION

Over a period of time, Machine Learning has significantly altered our lives. Nowadays, one can see machine learning applications in the form of recommendation systems, self-driving cars, models for disease prediction/ survival rate prediction, etc. varied domains, like agriculture [1], e-commerce [2], the energy industry [3], detecting fault and performing diagnosis in machinery in different industries [4] and healthcare [5]. Also, in the education domain, machine learning can be used for designing a better and more liked curriculum [6], predicting the grades and results of students [7], providing recommendations for better education courses [8]; and modelling students for intelligent tutoring systems [9].

Machine learning is a specific domain of techniques belonging to Artificial Intelligence that use mathematical and statistical techniques to perform some learning of patterns or trends to solve specific problems.

The goal of Machine Learning is to create models that can be used by people and can have an impact on people as well as society as a whole.

With the rapid increase in the generation and growth of data from varied sources, Big Data has emerged as one of the major contributors for the development of efficient machine learning models for different tasks. Computers can learn from data inputs using machine learning algorithms, which then employ statistical analysis to produce numbers that fall inside a given range.

Artificial intelligence & Machine learning advances have reignited enthusiasm in creating systems that learn and think like humans. Various breakthroughs have been made by utilizing deep neural networks that have been trained in tasks including object identification, video games, and board games, attaining performance that is comparable to, if not better than, that of humans in some ways. In spite of their biological motivation and accomplishments, these systems are fundamentally different from human intelligence.

One such field that has gained huge benefits from artificial intelligence and machine learning is natural language processing. Natural language processing is a domain of artificial intelligence relating to the ability of computers to understand text and words in the manner that humans understand.

Natural language processing blends statistical, machine learning, and deep learning models with computational linguistics—rule-based modelling of human language. It is used to power computer programmers that translate text from one language to another, summaries vast amounts of material and respond to spoken commands, Voice-activated GPS systems, speech-to-text dictation software, customer care chatbots, digital assistants and other consumer conveniences are all examples of NLP in action. However, NLP is increasingly being used in corporate solutions to help businesses streamline operations, boost employee productivity, and make time critical processes simple.

Writing software that reliably determines the intended meaning of text or voice input is exceedingly difficult since human language is riddled with ambiguity. For natural language-driven applications to be useful, programmers must teach them to recognize and understand accurately from the beginning the irregularities of human language that take humans years to learn. These irregularities include homophones, sarcasm, idioms, and metaphors, exceptions to grammar and usage, and variations in sentence structure. Major NLP tasks include speech tagging & recognition, word sense disambiguation, sentiment analysis, natural language generation, named entity recognition, etc.

Natural language processing has further helped in building better, efficient and interactive chatbots. With the help of NLP, the machine learning models can write or respond in a human-like manner, but understanding the intricacies of a task may not be feasible by a machine learning model.

Natural Language Processing has enabled machine learning models to read/write in a manner almost similar to humans. However, being able to read or write does not mean that the models understand it. For instance, while writing an article or poem, Machine learning or Artificial Intelligence models mostly use a function or relation to guess which word or phrase should come next, this means they do know what comes next but not why it comes.

Moreover, there are certain challenges associated with natural language processing, such as, contextualization, ambiguity in words, homonyms; presence of certain words that are domain specific only and not used in common parlance, etc. In this context, this work considers and develops an effective chatbot system that uses Human Learning to enhance Machine Learning.

II. RELATED WORK

Artificial intelligence (AI) has had its ups and downs, but the last several years have seen outstanding growth by any standard metric of success. Recent breakthroughs in "deep learning," which involves learning massive neural-network-style models with numerous layers of representation, have accounted for much of this success. These models have made significant progress in a variety of areas, including speech recognition, object recognition and control [10] [11]. [12] developed a deep convolutional neural network [13] for object recognition that made the error rate of the previous algorithms on the previous benchmark almost half.

Convnets have dominated in recent years, by achieving almost humanlike performance on object recognition benchmarks [14] [15] [16]. Since the late 1980s [17], Hidden Markov Models have been the main strategy in automatic speech recognition. However, this framework has nowadays been replaced by deep learning methods [18].

The most popular methods for voice recognition today are fully neural network systems (Weng, Yu, Watanabe, & Juang, 2014) (Graves, Mohamed, & Hinton, 2013). Deep Learning concepts have also been used to the study of control problems with complex nature. Deep Learning and reinforcement learning techniques have been merged by V. Mnih et al. (2015) to build a "deep reinforcement learning" algorithm. This algorithm can play straightforward video games using game frames and score (Schaul, Quan, Antonoglou, & Silver, 2016), (Guo, Singh, Lee, Lewis, & Wang, 2014) and achieves high levels of performance (Stadie, Levine, & Abbeel, 2015).

This paper's main purpose is to suggest a collection of key ingredients for creating more human-like learning and thinking chatbots. Some papers have directly compared the capabilities of humans and machines i.e. how a task that seems difficult to machines, seems natural to humans such as recognizing faces, driving vehicles, etc. [19]. Using deep learning to understand the meaning of words has also been a topic of discussion [20].

International Journal of Science, Engineering and Technology

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The use of game theory and the ability of machines to beat humans in certain strategy games have also been discussed. Some researchers have also studied the ability of new machine learning models to beat old rule-based models in said games [21]. However, most of the papers published in recent years have denoted that machine have yet to show signs of imagination or common sense that humans possess. In the next section, application domains of chatbots are discussed.

III. APPLICATION DOMAINS

In place of direct communication with a live human agent, a chatbot or chatterbot can be used. Effectively, it is a software application that conducts an online chat conversation using text or text-to-speech and assist clients by automating conversations and interacting with them via messaging networks [20]. Chatbot systems are often required to be tuned and tested on a regular basis in order to accurately replicate how a human would act as a conversational partner.

Figure 1 represents the main application domains of chatbots. The uses of chatbots are endless, they can be used in almost every industry with their main focus being on leveraging human efforts. Engaging in small talks or extracting information can be exhausting for humans.

Fig 1. Major Application Domains of Chatbots.

One of the major application areas of chatbots is in the retail and e-commerce. Such chatbots are able to provide customer support, information about specific products and services, etc. Some examples are: Allstate's Business Insurance expert chatbot, Microsoft Azure's Flo, Kinvey's Naïve Chat, Finn AI, Clinc, IBM Watson's Conversation, etc.

In case of healthcare, there are various chatbots like AdaHealth's Artificial Intelligence powered telemedicine app known as "Ada- Your Health Guide", Babylon Health's Ask Babylon, which on the basis of input symptoms, provide disease diagnosis. Other such chatbots include Symptomate from Infermedica, Woebot for mental health analysis, etc. Chatbots with optimal training can assist students in their studies by conducting quick study sessions or interacting like flash cards.

They can help decrease the workload on teachers, by handling repetitive work like surveys.

Chatbots are mainly used to get feedback from the user, this feedback could be used for varying purposes like testing a new product, or improving an existing one, or it might be using the feedback to improve its own capabilities like this model.

Even in the other domains like travel & hospitality, media & entertainment, education and legal, one has various chatbots. One interesting application of chatbots is in providing companionship to the people. Russian company known as Endurance has developed chatbot for providing companionship to senior citizen and elderly people. This chatbot speaks to the elderly on varied topics like weather, news, music, movies, etc. and share interesting facts.
In the next section, detailed methodology of the proposed chatbot is discussed.

IV. METHODOLOGY

To ensure correct and appropriate results, we require human interaction in addition to the accuracy metric. To do so, the process is divided into different phases:

1. Dataset Preparation:
The initial dataset used would be the Cornell movie dialog corpus which consists of more than 200,000 conversations, this dataset would be used for interacting with humans and asking for their responses. The dataset is extracted from movies and contains their entire conversations making it ideal for learning human communication; the entire dataset is recorded in English. This dataset will help

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the bot in learning not only a one-on-one reply but the ability to converse based on previous sentences also. Along with it, a word book, Putnam's Word Book by Louis A. Flemming was also used to differentiate between nouns, verbs, etc. This allowed the model to learn some conventional rules related to English grammar.

2. User Responses:
For the case of cluster learning, we will provide the user with a certain phase and ask them how they relate to it, and the following response would be stored by the model. For improving its user interaction, we will similarly ask the user for feedback on the model's responses, this feedback would be used to further train the model.

3. Using Deep Neural Networks:
Deep learning would be used to create a model for the above-mentioned tasks. Several different models would be created and will be put together to function such as Sentiment Analysis, Feedback Learning, Chatbot, etc.

The most important factor here is human interaction as these models are ultimately being developed for humans. So human feedback is essential to test these models.

4. Feedback:
Conversation with the user will be stored and will be used to train the model further to gradually incorporate the users' habits and commonly used words.

5. User Interface:
It is extremely important to have a user-friendly UI in order to extract the best responses from the user, thus we have spent a good amount of time designing and testing the user interface.

6. Working:
The chatbot first address the user, following which the user will input their sentence, this input will then be passed on to the chatbot model, which will perform two things: Transfer the input to the sentiment analysis model and get an appropriate label. Next, the label and the prediction model are used to predict a sentence appropriate for the chat.

Following this the user, we will rate the output and if found useful to the user would be sent to the dataset for further improving the accuracy of the model. This is represented in the Figure 2 as shown below.

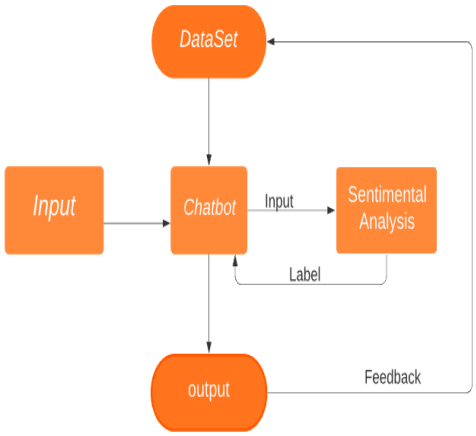

Fig 2. Flowchart of working of the proposed chatbot

The chatbot receives the user input and after processing it generates the most appropriate reply. It is based on a greedy approach. The response of the chatbot corresponding to a question is shown in Figure 3.

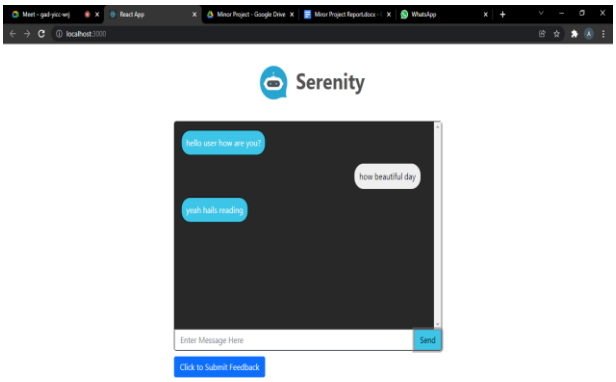

Fig 3. Screenshots of chatbot response.

The machine aims to converse exactly like humans where even the abstract meaning dialogues can be understood and responded. The sentences are a little abstract but they can be made sense of. This displays the superior human language skills that the machine cannot yet comprehend.

V. RESULTS

For a batch size of 16 the maximum accuracy attained by the model can be represented by Figure

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4 as shown below. The model achieved an accuracy of 82% on the training data.

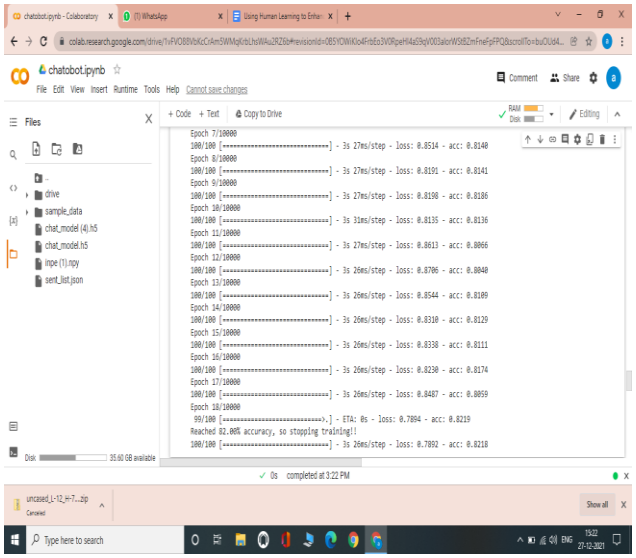

Fig 4. Model Accuracy of the Chatbot.

VI. CONCLUSIONS & FUTURE WORK

The use of feedback learning can enable chatbots to become personalized to their user. Hence, improving their ability to understand and communicate properly with the user. Understanding sentence patterns can enable the bot to interact in a more human way. As the model was trained on only 5000 sentences, this accuracy is quite good. The model can perform better if more data could be added.

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