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COMPARATIVE STUDY OF STATISTICAL AND NEURAL NETWORK LANGUAGE MODELLING IN SENTENCE GENERATION

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Abstract - *Natural Language Processing(NLP) is a field in machine learning with the ability of a computer to understand, analyze, manipulate, and potentially generate human language. NLP is a subfield of linguistics, computer science, information engineering, and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to process and analyze large amounts of natural language data. In this work, we propose an comparative study on the statistical and neural network language model based on its accuracy of performance. The language models are built for both the statistical language model and neural network language model. The developed models will predict the expected outcomes based on the input given to the model. The input is converted from speech to text by automatic speech recognition. The outcome is used to identify which language model results has better performance.*

Key Words: Natural Language Processing, Language Model, Statistical Language Modelling, Neural Language Modelling, Automatic Speech Recognition

1. INTRODUCTION

NLP is a subfield of linguistics, computer science, information engineering, and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to process and analyze large amounts of natural language data.[6]The language model provides context to distinguish between words and phrases that sound similar. Language modelling is used in speech recognition, machine translation, part-of-speech tagging, parsing, Optical Character Recognition, handwriting recognition, information retrieval and other applications.[1] In speech recognition, sounds are matched with word sequences. Statistical Language Modelling is the development of probabilistic models that are able to predict the next word in the sequence given the words that precede it. It is a probability distribution over sequences of words. [3]

Given such a sequence, say of length m, it assigns a probability to the whole sequence. The language model provides context to distinguish between words and phrases that sound similar. Neural Language Modelling approaches are achieving better results than classical methods both on standalone language models and when models are incorporated into larger models (speech recognition and machine translation).It is a language model based on Neural Networks, exploiting their ability to learn distributed representations to reduce the impact of the curse of dimensional. [5]

Currently, however the field of natural language processing is shifting from statistical methods to neural network methods [2]. There are still many difficult problems to solve in natural language processing. Nevertheless, deep learning methods achieve the most modern results for some specific language problems [1]. Not only the performance of deep learning models on benchmarking problems is the most interesting; the fact is that a single model can learn the meaning of a word and perform language tasks, eliminating the need for specialized and manual methods. In this paper are presented the most interesting natural language processing tasks, such as language modelling, in which deep learning methods achieve some progress [1].

Deep learning and natural language processing (NLP) is an area of computer science and artificial intelligence concerned with the interactions between computers and human (natural) languages, in particular how to program computers to fruitfully process large amounts of natural language data.

Challenges in natural language processing frequently involve speech recognition, natural language understanding and natural language generation [1]–[3] Speech recognition is the problem of understanding what was said. The task of speech recognition is to map an acoustic signal containing a spoken natural language utterance into the corresponding sequence of words intended by the speaker [1]. Given an utterance of text as audio data, the model must produce human readable text. Given the automatic nature of the process, the problem may also be called automatic speech recognition (ASR). In the literature can be found many examples of deep learning applications for speech recognition [4]–[10]. More and more often a language modelling is used to create the text output that is conditioned on the audio data [3].

Language modelling is really a subtask of more interesting natural language problems, specifically those that condition the language model on some other input. The main problem of language modelling is to predict the next word given the previous words [18]–[20]. The task is

fundamental to speech or optical character recognition, and is also used for spelling correction, handwriting recognition, and statistical machine translation [3].

2. System Design

The system comprises of main 3 concepts :

2.1 Automatic Speech Recognition(ASR)

NLP is much more important than directed dialogue in the development of speech recognition systems. The way it works is designed to loosely simulate how humans themselves comprehend speech and respond accordingly. Speech recognition is an interdisciplinary subfield of computer science and computational linguistics that develops methodologies and technologies that enable the recognition and translation of spoken language into text by computers. It is also known as automatic speech recognition (ASR), computer speech recognition or speech to text (STT). It incorporates knowledge and research in the computer science, linguistics and computer engineering fields.

2.2 Statistical Language Model(LM)

Statistical Language Modeling, or Language Modeling and LM for short, is the development of probabilistic models that are able to predict the next word in the sequence given the words that precede it. A language model is a function that puts a probability measure over strings drawn from some vocabulary. A language model learns the probability of word occurrence based on examples of text. Simpler models may look at a context of a short sequence of words, whereas larger models may work at the level of sentences or paragraphs. Most commonly, language models operate at the level of words. Language modeling is a root problem for a large range of natural language processing tasks. More practically, language models are used on the front-end or back-end of a more sophisticated model for a task that requires language understanding. Similarly, language models are used to generate text in many similar natural language processing tasks, for example like Optical Character Recognition Handwriting Recognition Machine Translation Spelling Correction Image Captioning Text.

2.3 Neural Language Model(NLM)

Neural Networks in language modeling is often called Neural Language Modeling, or NLM for short. Neural network approaches are achieving better results than classical methods both on standalone language models and when models are incorporated into larger models on challenging tasks like speech recognition and machine translation. Neural Language Models (NLM) address the n-gram data sparsity issue through parameterization of words as vectors (word embedding) and using them as inputs to a neural network. The parameters are learned as part of the training process. Word embedding obtained through NLMs exhibit the property whereby semantically close words are likewise close in the induced vector space. The neural network approach to language modeling can be described using the three following model properties

1. Associate each word in the vocabulary with a distributed word feature vector.
2. Express the joint probability function of word sequences in terms of the feature vectors of these words in the sequence.
3. Learn simultaneously the word feature vector and the parameters of the probability function.

3. MODULE DESCRIBTION

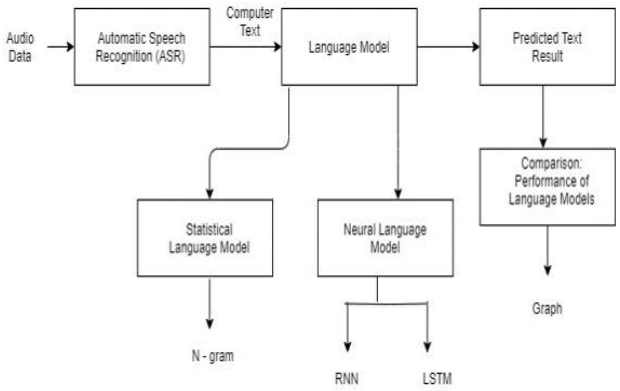

Fig -1: System Architecture

The Above Architecture shows the proposed solution. The Audio input needed for prediction is provided through the microphone and it is then converted to text by using Automatic Speech Recognition(ASR). The sentences related to this input is resulted from the model output. The statistical and neural network language model is trained using a data set to learn the models to predict the outcome accordingly. The data set used is text dataset from amazon Web Services(AWS). S3 Amazon(aws) is an online cloud based storage web service. The S3 actually stands for Simple Storage Service. The language model is trained based on the data set provided by using N gram and the probability. The outcome is also provided according to the input. The Language Model is trained based on the data set provided by using RNN and LSTM .The outcome is also provided according to the input and the accuracy of these 2 models are compared. The graph is plotted based on the performance.

Objectives:

1. Research on NLP
2. Research on Language models on statistical and neural network
3. Comparative study on the performance of Language Models

3.1 Statistical Language Modeling

A statistical language model is a probability distribution over sequences of words. The language model provides context to distinguish between words and phrases that sound similar. A statistical language model is learned from raw text and predicts the probability of the next word in the sequence given the words already present in the sequence. Language models are a key component in larger models for challenging natural language processing problems, like machine translation and speech recognition. The dataset used is from Amazon Simple Storage Service (Amazon S3) is an object storage service that offers industry-leading scalability, data availability, security, and performance. This means customers of all sizes and industries can use it to store and protect any amount of data for a range of use cases, such as websites, mobile applications, backup and restore, archive, enterprise applications, IoT devices, and big data analytics. The Training Models are developed for the statistical language model as a reference for the prediction of output.

The Statistical Language model is been developed using the dataset. The dataset used is S3 Amazon is an online cloud based storage web service. The S3 actually stands for Simple Storage Service (Nietzsche Philosophy as the dataset). The Model is been implemented using N Gram concept. The set of 2 words the bigram concept is been implemented for the development of the model. The trained model is been placed for the prediction.

3.2 Neural Language Modeling

Recurrent Neural Network(RNN) are a type of Neural Network where the output from previous step are fed as input to the current step. RNN have a "memory" which remembers all information about what has been calculated. It uses the same parameters for each input as it performs the same task on all the inputs or hidden layers to produce the output. Long short-term memory (LSTM) is an artificial recurrent neural network (RNN) architecture used in the field of deep learning. The dataset used is from Amazon Simple Storage Service (Amazon S3) is an object storage service that offers industry-leading scalability, data availability, security, and performance. This means customers of all sizes and industries can use it to store and protect any amount of The Training Models are developed for the Neural language model as a reference for the prediction of output.

The Neural Language model is been developed using the dataset. The dataset used is S3 Amazon is an online cloud based storage web service. The S3 actually stands for Simple Storage Service (Nietzsche Philosophy as the dataset). The Model is been implemented using the combined concept of both RNN and LSTM . The trained model is been placed for the prediction.

3.3 ASR and Testing of Statistical Language Model

In which the first step is to convert the voice input that we provide to the system to convert into an text output. The audio signal that we pass through the headset or the microphone is converted to text by using Automatic Speech Recognition(ASR). Thus audio signal is getting converted to text. The training models are developed for statistical based on the dataset. The audio which is been converted into text using ASR is taken as the input to statistical models are got loaded into this. The loaded model will compare with the input given and produce the text output. The Language Model predict the output and it gets stored in a file location in system.

3.4 ASR and Testing of Neural Language Models

The first step is to convert the voice input that we provide to the system to convert into an text output. The audio signal that we pass through the headset or the microphone is converted to text by using Automatic Speech Recognition(ASR). Thus audio signal is getting converted to text. The training models are developed for neural network based on the dataset. The audio which is been converted into text using ASR is taken as the input to neural network models are got loaded into this. The loaded model will compare with the input given and produce the text output. The Language Model predicts the output and it gets stored in a file location in system.

3.4 Comparison of Performance of Language M

The statistical and neural language models are compared for their performance. The techniques used in neural language modelling makes it to produce more accurate and effective results than the statistical language modelling. Once the outputs are saved in the corresponding location as we needed as a text file. The parameters used for the comparison are fuzzy and time. The time denotes how effectively the model was able to produce the output within a specific time. The fuzzy means the capability of recognizing, representing, manipulating the data that is been provided which is vague or which lack certainty. From the comparison we come into a conclusion that neural language models are more effective than the statistical language models in the case of sentence generation

4. CONCLUSIONS

In this project, The study on language models to understand how the text are getting generated. The comparative study of both statistical and neural network language models will help us to know about the different methods and how each model is better than the other. The accuracy of both the models are considered for evaluating the sentence generation. The sentences are getting generated for both models according to the input. The input is provided as an

audio and it is converted to text by automatic speech recognition.

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