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# NLP SENTENCE GENERATOR

GENERATING SENTENCES USING A TWEET CORPUS

JOSH WEIN
CSE 390 – NATURAL LANGUAGE PROCESSING
Final Project Report

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## 1 Introduction

For the final project I implemented a sentence generator using NLP techniques and strategies I learned during the semester as well as new ones I implemented to help with the process. The application is backed by a database of tweets with 604,862 tweets spread out into 273,010 topics. When I came up with the idea for this project it was to see if it was possible to generate at least pseudo-sensible sentences using samples of tweets around a given topic.

### 1.1 Uses

While this application does not provide a high accuracy model of grammatical correctness, it gives some insight into the similarities of different individuals' way of speaking. By taking all of the sentences surrounding a certain topic, it's possible to generate new sentences that can be passed off as a human generated sentences. This application gives an insight into the base layer of different AI techniques used in chat-bots and personal assistants. It's a good starting point for expanding towards more grammatically correct sentence generation and other uses.

### 1.2 Input and Output

Sentence generation is the process of outputting sentences in a human readable form given some input of some corpus of information that can be parsed and analyzed. To give the application a better form of structure it uses two separate inputs, a user chosen topic, and a precompiled list of sentences and topics in a server-side database. The details and structure of these inputs are discussed in more detail in Section 2: System Description. Using these two inputs, the application creates MLE based language models with which it randomly generates sentences using rejection sampling.

### 1.3 Example Outputs

To give an idea of how well the application can work here are a couple of examples of good output:

> Input: food
>
> Output: *Attempting to clean a magasine named Sirene. Exiting! Soooon food! Haha.*
>
> Input: school
>
> Output: *Seriously, school tommorrow... nooooooooooo!!!!!!!!*

Some bad output:

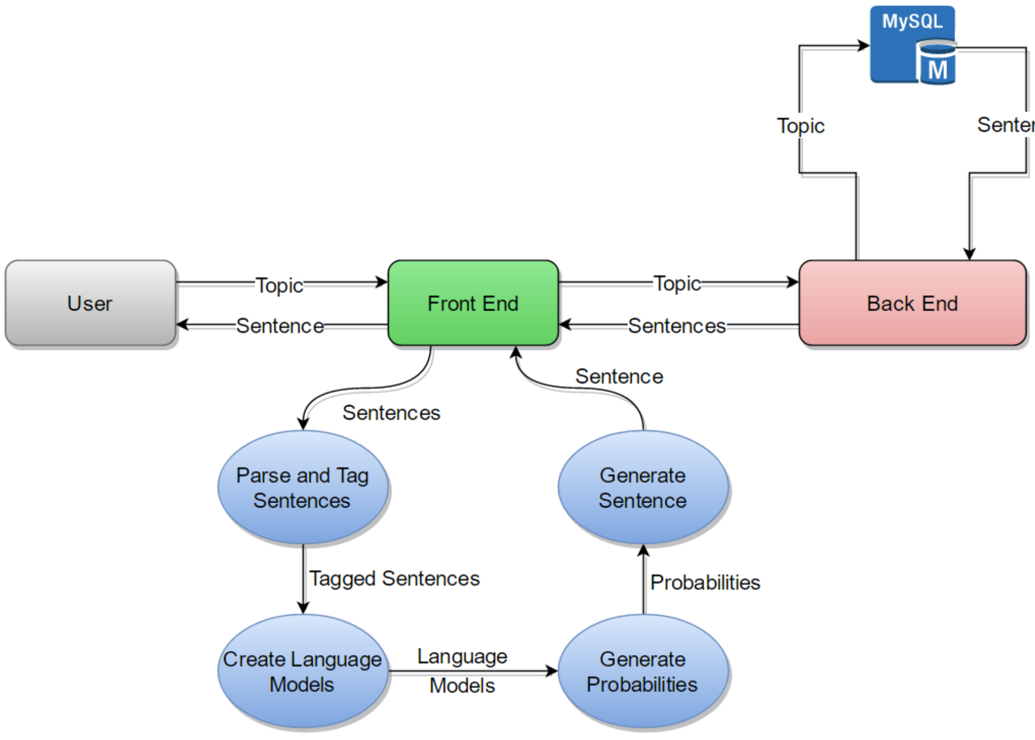
> Input: school
>
> Output: *In I.T. Bored to start babysitting for school... all good mood. My good bye seniors*
>
> Input: rain
>
> Output: *good want rain. Why rain - back in. I'm mad man Rhode Island tonight. . uh oh, it looks to wait to rain... going scuba diving tomorrow.*

## 2 System Description

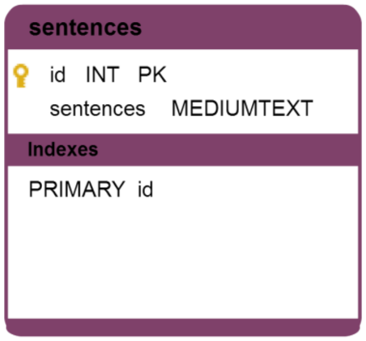
This section covers the specifics of how the application actually functions. The first part contains diagram overviews of the application and the second part discusses the steps taken by the application to generate the sentences. The way the database was created and how the data was initially parsed is not discussed here, but is discussed in more detail in Section 5: Discussions and Conclusions.

### 2.1 System Diagrams

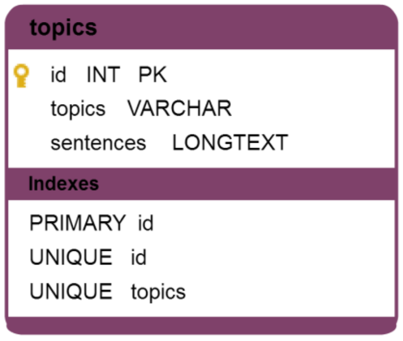
#### 2.1.1 Overall Application Layout



#### 2.1.2 Database Table Layouts



| sentences | |
|---|---|
| id INT PK | |
| sentences | MEDIUMTEXT |
| **Indexes** | |
| PRIMARY | id |



| topics | |
|---|---|
| id INT PK | |
| topics | VARCHAR |
| sentences | LONGTEXT |
| **Indexes** | |
| PRIMARY | id |
| UNIQUE | id |
| UNIQUE | topics |

### 2.2 System Overview

In order to use the application all the user needs to enter is a topic. As long as it's one word and shorter than 50 characters, the topic gets sent to the server. The server then checks the database for the topic and if it exists in the database, all of the sentences for that topic are pulled and sent back to the client front end.

The first step in the sentence generation is preparing the tweets. Each tweet is parsed, any empty tokens are removed, and starting and ending tokens are added to it [<s>, </s>]. Once every tweet has been parsed, the list of sentences gets sent to the next routine to generate the language models. The language models generated are unigrams (single-word) with counts and bigrams (double-word) with counts. The language models are used to create an MLE based probability model.

The final routine takes the bigrams and the probabilities to generate sentences using the probabilities as weights for rejection sampling. Starting with the start tag (‘<s>’), a list of possible bigrams are generated and chosen from to create the sentence until it reaches the end of the sentence. This final routine will continue running until a sentence is generated before the upper limit on length and it contains the topic. It does this by checking for an ending tag (‘</s>’) after each word generation.

## 3 NLP Techniques Used

Three main techniques were used in implementing this application: MLE Probability, Rejection Sampling, and a backoff implementation for handling the random value.

### 3.1 MLE Probability Model

The maximum likelihood estimation model is a statistical model used for getting the likelihood of certain observations. MLE’s simple equation gives the highest probability for training data. MLE is usually an unsuitable method for most NLP related tasks but we don’t deal with any unknowns in this application; therefore MLE doesn’t cause any problems for us.

The equation used for MLE is:

$$\frac{count(bigram)}{count(unigram)}$$

For example with the bigram “go home” the equation would be:

$$\frac{count("go\ home")}{count("go")}$$

This results in an even probability distribution across the board making it easy to filter out lower probabilities if needed and choose words.

### 3.2 Rejection Sampling

Rejection sampling is a technique used to distribute probabilities over a graph while keeping the density function the same allowing for a random variable to be sampled easily. I used this idea to create a table populated by the bigram indexes based on their probabilities to give them an accurate weight distribution.

### 3.3 Back-off

I used the back-off technique we learned about earlier on in the semester to help create a routine to get the next random tag. The user is able to specify a general randomness in the application from a scale of “Less Random” to “More Random”. The randomness specifies what probabilities to include or exclude from the calculations. If the rejection sampling does not yield any results then we back-off the randomness, by lowering the allowed probability until we get results to choose from. This means that that we always have choices no matter the randomness chosen.

## 4 Evaluation

It’s difficult to objectively evaluate the accuracy of this application since there isn’t any baseline for generating sentences. This is also due to the type of data being used; most of the data itself isn’t grammatically correct to begin with. If we were using a data set that was known to be grammatically correct then we could check if the sentences generated were grammatically correct as well. Since that’s not the case, it’s expected that sentences generated will not be grammatically correct.
With that being said, it’s still possible to look at the results and see that it does work to some extent. Some generated sentences seem indistinguishable from a tweet someone could have posted, while others are obviously nonsense. The third category of generated sentences rides the line between the two, in a sort of uncanny valley way, where it just barely misses being seen as human generated content like the sentence: “My fone is on the time on ebay, someone else needs 2 GO SHOPPING RIGHT NOW!!!!” Many of the generated sentences share these similar features where it almost makes sense, and the sentence structure works, but there’s obviously something off in the content.

## 5 Discussion and Conclusions

Summarize what you've learnt from this project. This should include, challenges you encountered, what you did to solve them, a succinct explanation of results, and what you would suggest as future work to improve the system.

### 5.1 Challenges

## Resources and Referenced Material

Tweet Data – Sentiment140: http://help.sentiment140.com/for-students/

Rejection Sampling - https://en.wikipedia.org/wiki/Rejection_sampling

Application Hosting for Frontend and Database – OpenShift: https://www.openshift.com/

Twitter API - https://dev.twitter.com/

Twitter API Exchange Wrapper - https://github.com/J7mbo/twitter-api-php