Natural Language Processing for CRM Friendly Interface

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Abstract. Everything we express (either verbally or in written) carries huge amounts of information. The topic we choose, our tone, our selection of words, everything adds some type of information that can be interpreted and value extracted from it. In theory, we can understand and even predict human behaviour using that information. But there is a problem: one person may generate hundreds or thousands of words in a declaration, each sentence with its corresponding complexity. If you want to scale and analyze several hundreds, thousands or millions of people or declarations in a given geography, then the situation is unmanageable. Data generated from conversations, declarations or even tweets are examples of unstructured data. Unstructured data doesn't fit neatly into the traditional row and column structure of relational databases, and represent the vast majority of data available in the actual world. It is messy and hard to manipulate. Nevertheless, thanks to the advances in disciplines like machine learning a big revolution is going on regarding this topic. Nowadays it is no longer about trying to interpret a text or speech based on its keywords (the old fashioned mechanical way), but about understanding the meaning behind those words (the cognitive way). This way it is possible to detect figures of speech like irony, or even perform sentiment analysis. Such technologies are ideal for creating chat bots. And friendly interfaces are a core part of the CPM system for commerce. In this article, we discuss the basic principles of these components of the system and the features of their interaction

Keywords: NLP, CRM, CUI

1 Introduction

How exactly does natural language processing work? The short answer is it works by breaking the language into elementary parts. But of course, it is worth considering this topic in much more detail.

Natural language processing includes many different methods of interpreting human language, from statistical and machine learning methods to rules and algorithmic approaches. A wide range of approaches is required for different needs.

The main tasks of NLP include tokenization and parsing, lemmatization / steming, part of speech marking, language detection and identification of semantic

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connections. If you've ever diagrammed a sentence in high school, you've done these tasks manually before.

In general, the task of NLP is to break language into shorter, more elementary parts, trying to understand the relation between particles, and exploring how parts work together to make sense.

2 Formulation of the Problem

CUI allow you to gather a lot of information about customers, but they will not be classified, and therefore require a lot of work to process. Therefore, it is necessary to consider NLP as a tool that will automate the process of communication with the client, and choose a technology that will provide the ability to obtain unambiguous structured data.

3 Analysis of Recent Research and Publications

Articles on the use of NLP for CUI purposes are not presented, so the articles on both topics are analyzed separately. After analyzing the articles, it was decided to focus research on the specifics of the use of NLP for chatbots. Take into account the features and prospects of working with the Ukrainian language, as these topics are not discussed in detail in the works.

4 Formulation of the Purpose of the Article

Research of natural language recognition means, analysis of methods of recognition of their comparison and analysis of importance for performance of CUI functions

5 Main Part

Approaches in NLP:

- Statistical approach

The statistical approach to natural language processing assumes that the content of the text can be determined by the most commonly used words. The main task of this approach is to determine the number of repetitions of a particular word in the text. The symbolic approach to natural language processing is based on human-developed regulations and lexicons. The foundation behind this approach is in generally approved regulations of speech within a specific language which is materialized and recorded by experts.

- Symbolic approach

The symbolic approach to natural language consists in an in-depth analysis of linguistic results and is based on the explicit presentation of knowledge, which should

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be used only by the studied schemes of knowledge representation and algorithms that should be with them. The source knows that you can use dictionaries, formulas and rules developed by people.

- Connective approach

The connective approach to natural language processing is a mixture of the symbolic and statistical approaches. This approach starts with generally approved rules of language and converts them to specific applications from input procured from statistical inference.

- Auxiliary vector method

Differential method of machine learning, which helps to classify words into categories. This method is based on a certain set of properties.

- Hidden Markov model

It is a graphical system that uses the true version, which is a common story that can be used at any time, and when they are very important between them, they share one of almost all of their possible characters with each transition. The set of all possible states and unique symbols can be large. We can see the original messages, but the original old systems are hidden.

- N-gram models

The model is built on a series of n elements: sentences, words, letters, sounds, etc. The model allows you to calculate the probability of any element for the known probabilities of such previous elements. Such a model is reduced to a finite set of probabilities, each of which can be estimated after calculating the repeatability of the corresponding n-grams.

- Linguistic approach

The linguistic approach to natural language processing consists of four levels: graphematic, morphological, syntactic and semantic.

Morphological Level: Morphemes are the smallest units of meaning within words and this level deals with morphemes in their role as the parts that makeup word.

Lexical Level: This level of speech analysis examines how the parts of words (morphemes) combine to make words and how slight differences can dramatically change the meaning of the final word.

Syntactic Level: This level aims at text at the sentence level. Syntax rotates around the plan that in most languages the sense of a sentence is dependent on word order and dependency.

Semantic Level: Semantics focuses on how the context of words within a sentence helps determine the meaning of words on an individual level.

6 Example of Work

- Tokenization by sentences

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Sentence tokenization is the process of dividing written language into component sentences. The idea looks simple. In English and some other languages, we can distinguish each when we find a specific punctuation mark - a period.

```
Backgammon is one of the oldest known board games. Its history can be traced back nearl
y 5,000 years to archeological discoveries in the Middle East. It is a two player game
where each player has fifteen checkers which move between twenty-four points according
to the roll of two dice.
```

Fig. 1. Example text for tokenization by sentences

```
text = "Backgammon is one of the oldest known board games. Its history can be traced back nearly 5,000
sentences = nltk.sent_tokenize(text)
for sentence in sentences:
    print(sentence)
    print()
```

Fig. 2. Example code for sentence tokenization

At the output we get:

```
Backgammon is one of the oldest known board games.

Its history can be traced back nearly 5,000 years to archeological discoveries in the M
iddle East.

It is a two player game where each player has fifteen checkers which move between twent
y-four points according to the roll of two dice.
```

Fig. 3. The result of tokenization by sentences

- Tokenization by words

Word tokenization is the process of dividing sentences into component words. In English and many other languages, using one or another version of the Latin alphabet, a space is a good word separator. However, it may solve the problem if we use only space.

```
for sentence in sentences:
    words = nltk.word_tokenize(sentence)
    print(words)
    print()
```

Fig. 4. Example text for word tokenization

```
['Backgammon', 'is', 'one', 'of', 'the', 'oldest', 'known', 'board', 'games', '.']

['Its', 'history', 'can', 'be', 'traced', 'back', 'nearly', '5,000', 'years', 'to', 'ar
cheological', 'discoveries', 'in', 'the', 'Middle', 'East', '.']

['It', 'is', 'a', 'two', 'player', 'game', 'where', 'each', 'player', 'has', 'fifteen',
'checkers', 'which', 'move', 'between', 'twenty-four', 'points', 'according', 'to', 'th
e', 'roll', 'of', 'two', 'dice', '.']
```

Fig. 5. The result of tokenization by words

- Lematization and stamming of the text

Texts contain different grammatical forms, the same words at the same time, and you can find homogeneous words. Lematization and stemming allow to unify all forms of the word. This stage is very important for CUI because it is the final stage of recognizing commands in the text.

```
from nltk.stem import PorterStemmer, WordNetLemmatizer
from nltk.corpus import wordnet

def compare_stemmer_and_lemmatizer(stemmer, lemmatizer, word, pos):
    """
    Print the results of stemmind and lemmitization using the passed stemmer, lemmatizer, word and po
    """
    print("Stemmer:", stemmer.stem(word))
    print("Lemmatizer:", lemmatizer.lemmatize(word, pos))
    print()

lemmatizer = WordNetLemmatizer()
stemmer = PorterStemmer()
compare_stemmer_and_lemmatizer(stemmer, lemmatizer, word = "seen", pos = wordnet.VERB)
compare_stemmer_and_lemmatizer(stemmer, lemmatizer, word = "drove", pos = wordnet.VERB)
```

Fig. 6. Code for tokenization for lemmatization

```
Stemmer: seen
Lemmatizer: see

Stemmer: drove
Lemmatizer: drive
```

Fig. 7. The result of lemmatization

7 How a Friendly Interface Integrates into CRM

What can work with such a system look like? We need to know the intent of the user - we will call it intent. Some examples of intentions - "request_weather", "request_restaurant", etc.

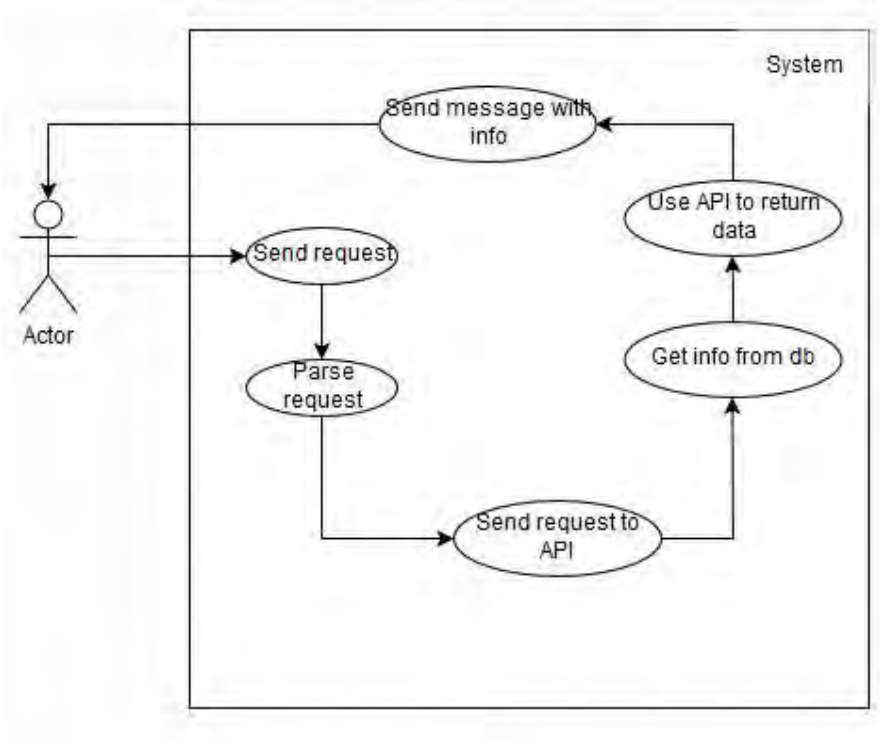

Fig. 8. Use Case diagram of system

We need to know the specific intentions in the query (we will call them entities), for example - the answers to the question when ?, where ?, how much? etc., which correspond to the extraction of information from the user's request for date, place and quantity, respectively. Here the date, place, number are entities. If we talk about the weather, the essence can be "datetime" (information provided by the user) and location (may not be explicitly entered by the user, but determined by default).

With intent and substance, we can make the appropriate API call to the weather service and get results.

Now that this chatbot is conversational, we need to keep track of all previous conversations so that we can predict the best and most anticipated response in the future. To do this, we need a dictionary that will store information about the current

intention, current entities, stored information about past questions and answers of this user, previous actions of the bot, the results of the API call.

Obtaining information about intentions and entities is a simple task, as a separate library for NLP will be used.

Getting the rest of the values (information provided by the user in response to previous bot requests, previous bot action, API call results, etc.) is a bit more complicated, so the dialog manager component should work here. These function values must be derived from the training data that the user will provide in the form of training conversations between the user and the bot. These training conversations should be prepared in such a way that they capture most of the possible scenarios of the conversation with the user.

If the plans are to build exemplary conversations from scratch, then one of the recommended ways is to use an interactive learning approach. I will not go into details, but, as the name implies, it is a program with a user interface that prompts him to enter queries, followed by a dialog manager that offers several options for the next step and encourages the user to choose the best, in his opinion, answer and determine your priority of learned choice. The model uses this feedback to improve its predictions in future work.

After the training, the chatbot can be as follows: respond to the user with a message, receive data from the database (if any), perform a call API and obtain some results that meet the intentions of the user. If an API is called or data is received, the conversation flow control will remain in the dialog management component, which will use and store the received information to predict the next action. The dialog manager updates the current state based on the action just performed and the results obtained to predict the next action. When the next action is a certain text response to the user's action, the message generation component comes into play. Message generation usually consists of several user-defined templates (templates are mostly sentences into which certain data can be substituted) and respond to action names. Therefore, depending on the actions provided by the dialog manager, the corresponding message template is launched. If the template requires the substitution of certain data, then these values are also transmitted to the message generator. After that, the corresponding message will be displayed to the user, and the bot goes into standby mode for the next action from the user.

8 Conclusions

NLP is a powerful tool for automating CUI. An analysis of the benefits and vulnerabilities of NLP has shown how the CUI technology used for the CRM system can be used.

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