
Named Entity Recognition and Relation Extraction

Bachelor's Thesis
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Bachelor of Technology
in
Computer Science and Engineering

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DECLARATION

I **NARAGAM SAI KIRAN**, with ID No:**N100638** hereby declare that the project report entitle **Named Entity Recognition and Relation Extraction** done by me under the guidance of **Mr. Ambati Udaya Kumar,M.Tech** is submitted for the partial fulfillment of the requirements for the award of the degree of Bachelor of Technology in Computer Science and Engineering during the academic session August 2015 April 2016 at RGUKT Nuzvid.

I also declare that this project is a result of my own effort and has not been copied or imitated from any source. Citations from any websites are mentioned in the references.

The results embodied in this project report have not been submitted to any other university or institute for the award of any degree or diploma.

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I would like to thank my parents,guide and friends

Abstract

Abstract goes here.

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Chapter 1

Introduction

When we have large amount of (previous) data we might want to extract some useful information out of it, and use it as summary. or we can predict the future events by learning from the data at hand.

Most of the time data that is available for use in un-structured form like Natural Language Text rather than structured form like tables. It is easy to extract required information or answer a question if the data we are working on has structured form.

But it is difficult to handle unstructured data. Because Natural Language Processing(NLP) that works on unstructured data is still developing.

The amount of natural language text that is available in electronic form is truly staggering, and is increasing every day. However, the complexity of natural language can make it very difficult to access the information in that text[1].

If we instead focus our efforts on a limited set of questions or "entity relations," such as "where are different facilities located, " or "who is employed by what company," we can make significant progress.[1]

Here we are trying to understand the given text and find the limited relevant parts of it. This is what the researchers called as **Information Extraction**.

1.1 Aim

Identifying named entities and working out the relationship between them using hand-written rules with regular expressions. For most of the questions often the answers be named entities.

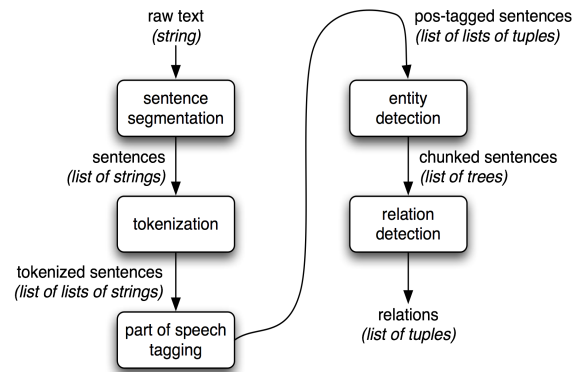


Figure 1.1: Simple Pipeline Architecture for an Information Extraction System[1]

Chapter 2

Named Entity Recognition

2.1 Introduction

Named Entity Recognition is an important sub task of *Information Extraction*, in this we are going to find and classify (into different classes like PERSON, ORGANIZATION and LOCATION etc.). concrete names of people, organizations, locations and quantities etc.

We are interested in *Named* Entity Recognition. Because not all entities are attached with a name (specific).

For the literature survey on named entity recognition, please refer[9].

2.2 Named Entity Recognition as Tagging

*Bikel et. al*¹ mapped the Named the Entity Recognition problem very directly into tagging problem. Where where they considered all the named entity classes and an extra NOT-A-NAME tag.

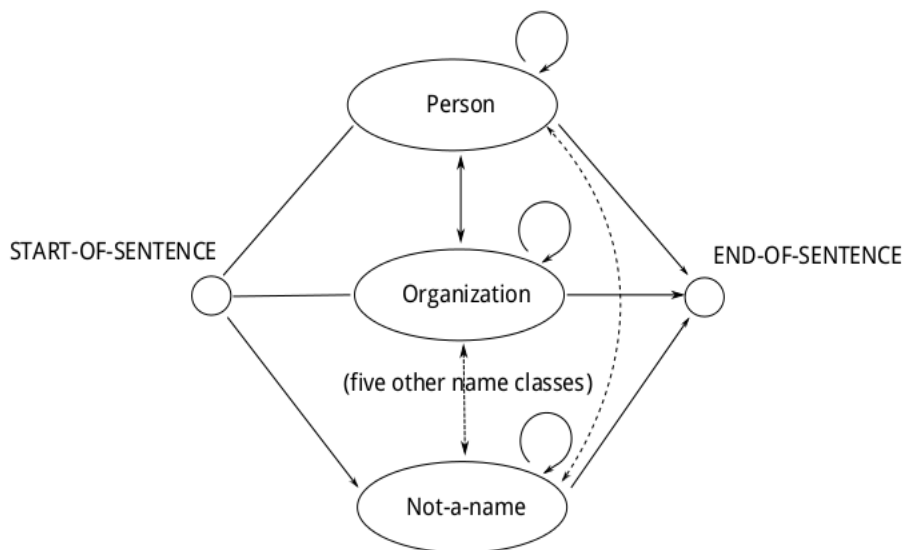


Figure 2.1: Stage Diagram of NER as Tagging by Bikel et. al

¹<http://ilk.uvt.nl/~toine/research/bikel-1999.pdf>

They used hand-tagged corpus to train their model (Hidden Markov Model[6]) and some word-features to deal with low-frequency words.

2.3 Named Entity Recognition with PoS tagging & Chunking

Now we have lot of parts of speech tagged corpora (especially for english) as we can use it for machine translation and many other applications. Here we are going to use PoS tagging for NER.

After having natural language sentences with their underlying *tag sequences* we group the tags into named entities.

2.3.1 PoS Tagging²

Parts of speech tagging problem is to determine the parts of speech of a particular instance of word. The intuition of PoS tagging is presented in below image 2.2³.

Tags may vary depending on corpus we are dealing with. For example, tag set of The Brown Corpus⁴ and P.O.S tag set of The Penn Treebank⁵ To check in NLTK, execute and `nltk.help.brown_tagset()`, `nltk.help.upenn_tagset()` respectively for the brown corpus tagset and Penn Treebank tagset.

If we want to write a tagger then we need *large amount of labeled corpus*⁶. Which in this case are Penn Tree Bank tagged corpus or Brown corpus.

For more insights on writing a parts of speech tagger in NLTK, please refer[2]

For theoretical understanding of a tagger. We learned how a Hidden Markov Model tagger[6] works. Here for this problem we used NLTK's default implementation of tagger(`nltk.tag()`) as it is recommended for better results.

Part-of-Speech Tagging

INPUT:

Profits soared at Boeing Co., easily topping forecasts on Wall Street,
as their CEO Alan Mulally announced first quarter results.

OUTPUT:

Profits/**N** soared/**V** at/**P** Boeing/**N** Co./**N** ./, easily/**ADV** topping/**V**
forecasts/**N** on/**P** Wall/**N** Street/**N** ./, as/**P** their/**POSS** CEO/**N**
Alan/**N** Mulally/**N** announced/**V** first/**ADJ** quarter/**N** results/**N** ./.

N = Noun
V = Verb
P = Preposition
Adv = Adverb
Adj = Adjective
...

Figure 2.2: Parts-of-Speech Tagging

²For more details:

Tagging Problems, and Hidden Markov Models of [7] and POS Tagging of [8]

³Slide from The Tagging Problem of [7]

⁴<https://www.comp.leeds.ac.uk/ccalas/tagsets/brown.html>

⁵https://www.ling.upenn.edu/courses/Fall_2003/ling001/penn_treebank_pos.html

⁶For more insights of Machine Learning techniques I feel, [4] is a good source

2.3.2 Named Entity Chunking⁷

After tagging comes the named entity chunking. We'll group the pos tags into named entities (if possible intuit its class). Chunker is also a tagger that is trained on some corpus. One of the most useful sources of information for NP-chunking(Noun Phrase-chunking) is part-of-speech tags. This is one of the motivations for performing part-of-speech tagging in our information extraction system

Here for this problem we used NLTK's default implementation of named entity chunker (*nltk.ne_chunk()*) as it is recommended for better results. It can be used for multi- class(PERSON, LOCATION, ORGANIZATION and GPE) or binary class(NP).

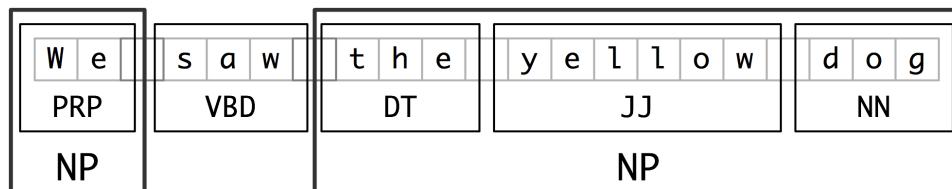


Figure 2.3: Chunking

For more insights on developing a chunker, please refer [1]. Here it described how to create a basic chunker and a chunker that can learn from data for good performance.

Morphology of words to identify Noun Phrases. And to identify the class of Noun Phrase(Named Entity) the chunker will use context of the Noun Phrase. There are many formats to represent Named Entities, those are IB(Every token is **I**n the chunk or **B**egining of the chunk), IOB(Every token is **I**n the chunk or **O**ut of the chunk or **B**egining of the Chunk),tree representation etc.

⁷For more details: refer [1]

Chapter 3

Relation Extraction

Relation Extraction is an important component of Information Extraction.

Using the Named Entities and clever patterns we extract relation. These rules can get high precision as they are specific.

We will focus on the simpler task of extracting **relation triples**. Relation triples are of the form *(Named Entity, Relation, Named Entity)*.

We will use *relextract* module of *Python* for this.

Rule based relation extraction We can create new structured knowledge bases by relation extraction Questions that are asked in natural language can be converted in to a query to a structured knowledge base.

So, Here is a question for us. *Which relations should we extract ?* It depends on how many classes of entities we are able to extract in *Named Entity Recognition*.

But, a set of relations comes from the *Automated Content Extraction (ACE)* task. 3.1¹

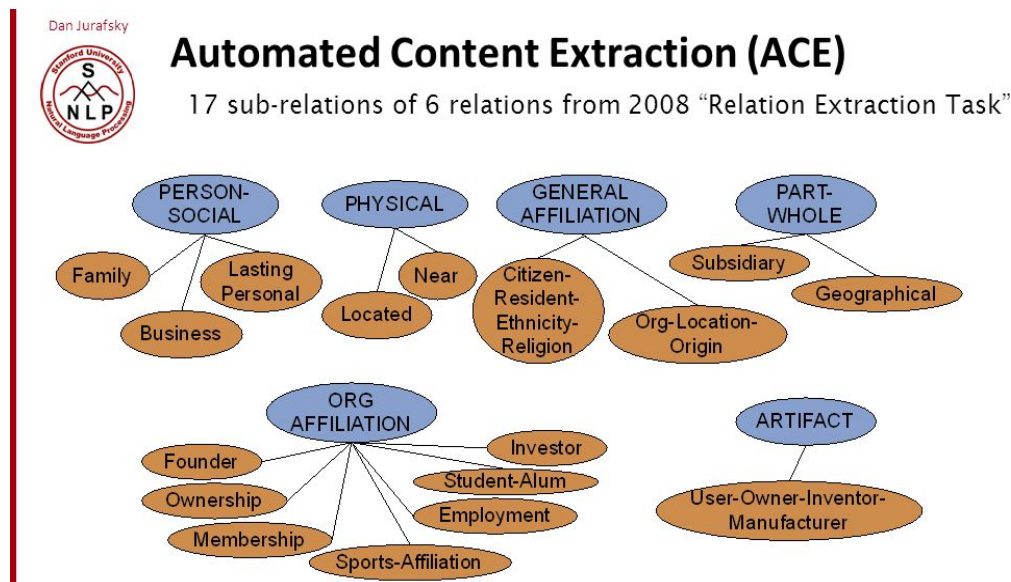


Figure 3.1: ACE Relation set

¹Slide from: <https://class.coursera.org/nlp/lecture/138>

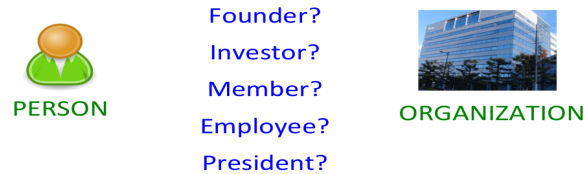


Figure 3.2: IE system

IE System 3.2²

3.1 How to extract relations ?

We can use:

- Hand-written patterns
- Supervised, semi-supervised and unsupervised machine learning

We are using *only* Hand-written patterns to extract relations as it is simplest way. Here we are trying to extract relations between *specific entities*.

We used **regular expressions** [5] in Python to write patterns to extract relations.

3.1.1 Positives of Hand-written rules

- String patterns tends to be high-precision.
- Works well for specific domains/entities.

3.1.2 Negatives of Handiwritten rules

- It's difficult to think of all possible patterns.
- We don't want to fix the entities for relation extraction.

²<https://class.coursera.org/nlp/lecture/139>

Chapter 4

Results and Observations

4.1 Observations

Named Entity Chunker provided in Python's NLTK (*nltk.ne_chunk*) considers morphology of words while chunking. Make sure that words are not normalized(HMMTagger requires words to be normalized) while chunking.

Trained HMMTagger(for PoS tagging) available in Python's NLTK with *treebank* tagged corpus and tried chunking but performance is not as good as NLTK's Recommended PoS tagger (*nltk.tag*). So, we used NLTK's Recommended PoS tagger for tagging sentences. It was found that NLTK's current recommended tagger is 'Averaged Perceptron Tagger'(It might change over time).

4.2 Results

For testing we used *BBC*'s corpus.

Chapter 5

Conclusion and Future Work

5.1 Conclusion

From the text we are going to extract information should a formal writing. For informal writings it won't work well as every steps assumes the formal nature of the text.

5.2 Future Work

Indian languages have very less *tagged* corpus compared to English. We require large amount of *tagged corpus* to train classifiers.

- To apply Named Entity Recognition & Information Extraction for Indian languages.

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