
Named Entity Recognition and Relation Extraction

Bachelor's Thesis
submitted in partial fulfillment of
the requirements for the degree of
Bachelor of Technology
in
Computer Science and Engineering

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CERTIFICATE OF COMPLETION

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This approval does not necessarily endorse or accept every statement made, opinion expressed or conclusion drawn, as a recorded in this thesis. It only signifies the acceptance of this thesis for the purpose for which it has been submitted.

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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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Date : _____

Palce: _____

Acknowledgements

I would like to thank **Mr. Ambati Udaya Kumar** for his exemplary guidance, monitoring and constant encouragement throughout the course of this thesis. I express my sincere thanks to him for making the resources available at right time and providing valuable insights leading to the successful completion of my project. I really enjoyed his 'visionay' discussions

I would like to thank RGUKT Nuzvid Director, faculty and staff for their valuable suggestions and discussions.

I place a deep sense of gratitude to my family members and my friends who have been constant source of information during the preparation of this project work.

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Abstract

Information Extraction is the task of extracting structured data out of unstructured data like natural language text as the structured data can be easily processed by a computing machine. So when we have unstructured data, we extract **relevant** information in structured form like tables and then use some queries to get **required** information.

Here we are doing Information Extraction, for that we do **Named Entity Recognition** and **Extract Relations** between considered named entities. Thus producing structured form of given natural language text. All the source code and documentation are hosted on **github**¹

¹<https://github.com/saikiran638/MyProjects/tree/master/FinalYearProject>

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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**. There are two subtasks in information extraction those are **Named Entity Recognition** and **Relation Extraction**. We work on both of them now.

1.1 Aim

Our aim is to identify named entities and working out the relationship between them using hand-written rules with regular expressions. We may use this system for question & answering. For most of the questions often the answers be named entities. The below image 3.2 will give an intuition of what we are going to do. That is the procedure followed.

For relevant, meaningful relation detection we use some regular expressions on that tuples. To host this project on **github**¹ for ease of access and modification.

To use BBC news data for testing purpose .

¹This project with its source code and documentation available at: <https://github.com/saikiran638/MyProjects/tree/master/FinalYearProject>

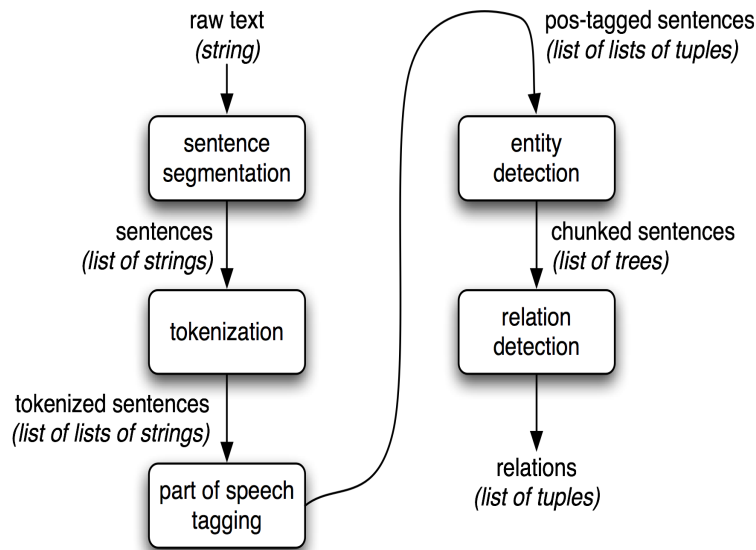


Figure 1.1: Simple Pipeline Architecture for an Information Extraction System[1]

1.2 Technologies Used

Language of choice is Python as it eases development with high-level data structures and modules built-in. Most important modules we used are :

- **nltk** (Natural Language Tool Kit module)

We used Python's Natural Language Tool Kit for implementation. It has good documentation and tutorials². It allows convenient access³ of corpus in different languages, and has many natural language processing methods implemented for better performance. We can use them for better results.

- **re** (Regural Expression module)

Provides convenient methods to write and test regular expressions. We used it to write rules while extracting relations.

²<http://www.nltk.org/book>

³<http://www.nltk.org/howto>

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.) the 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.

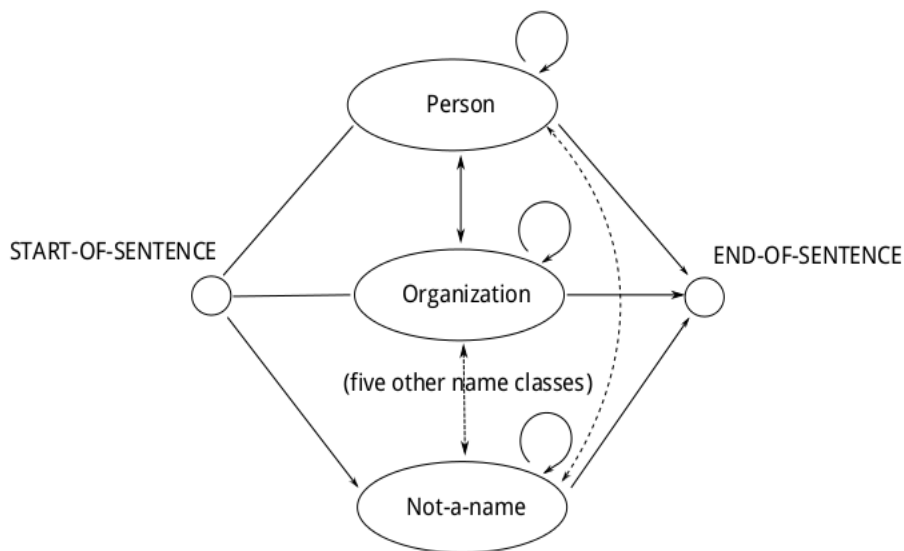


Figure 2.1: Stage Diagram of NER as Tagging by Bikel et. al

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 Tagging

Parts of speech tagging² 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 Chunking

After tagging comes the named entity chunking⁷. 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).

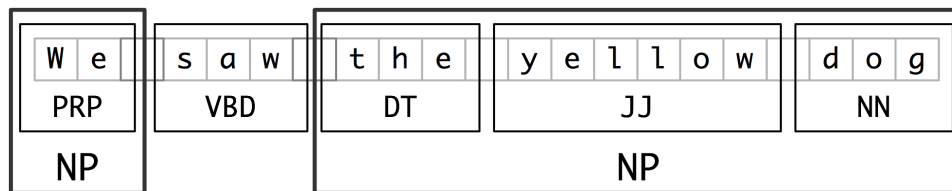


Figure 2.3: Chunking

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 use patterns to find whether Relation between those Named Entities is meaningful and relevant. Procedure is clearly explained in ??

We will use `relextract` module of Python's NLTK 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

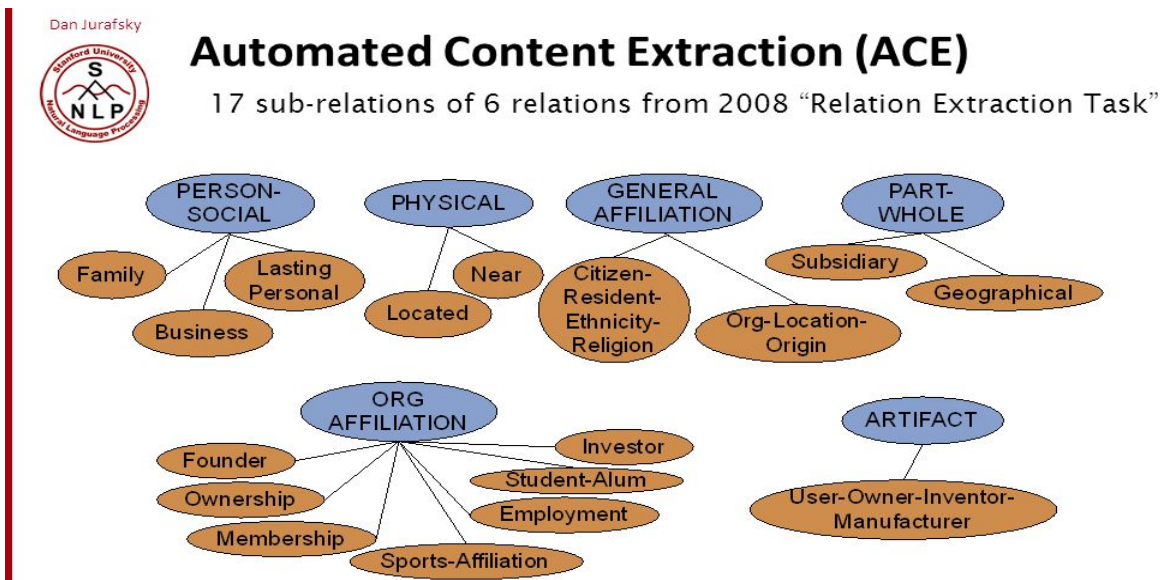


Figure 3.1: ACE Relation set

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

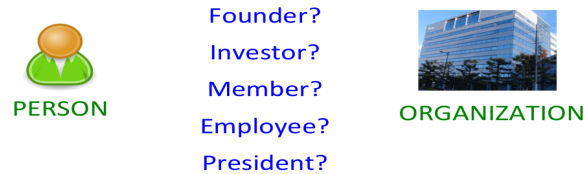


Figure 3.2: Relation between PERSON and ORGANIZATION named entity classes

Figure 3.2² gives basic intuition of relation between entities.

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 Procedure followed

- First identify the named entities (POS tagging then Chunking).
- Then we group a Noun phrase with its left context.
 Now we'll have document as list of tuples.
 Ex: [(String1, Named Entity1), (String2, Named Entity2) , (String3, Named Entity3) , ...]
 Here Named Entity1, Named Entity2, Named Entity3 are tree representations of Noun Phrase.
 Now we take two consecutive tuples and add them to create *semirelation* dictionaries.
 That dictionary contains **key, value** as described in table 3.1
- Apply hand-written rules on filler, right context and left context to extract relations

For more information on relation extraction, please refer [1] for more information. The rules we wrote for this project can be found here³

3.1.2 Positives of Hand-written rules

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

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

³<https://github.com/saikiran638/MyProjects/blob/master/FinalYearProject/RelationRules.py>

KEY	VALUE
filler(text between two Named Entities)	String2 which is leftcontext of Named Entity2
lcon(left context of the relation)	String1 which is leftcontext of Named Entity1.
objclass(Class of object of the relation)	Root of the Named Entity2 tree structure
objsym(Normalized text of object with no white space)	Normalized object with underscore in palce of space.
objtext	objtext
rcon(right context of the relation)	String3, which is right context of the Named Entity 2
subjclass(Class of subject of the relation)	Root of the Named Entity1 tree structure.
subjsym(Normalized text of sujet with no white space)	Normalized subject with underscore in palce of space.
subjtext	subject text
untagged_filler	filler with no POS tags

Table 3.1: Explanation of Key,Value pairs of **semirelation** dictionary

3.1.3 Negatives of Handiwritten rules

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

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

This project is hosted on [github](https://github.com/saikiran638/MyProjects/tree/master/FinalYearProject)¹, you can access source code and documents of it.

The relation extraction results for BBC **politics** news:

```
===== Relations of PERSON and ORGANIZATION =====
[PERSON: u'Carl/NNP Emerson/NNP'] , from the [ORGANIZATION: u'Institute/NNP']
[PERSON: u'David/NNP Redvers/NNP'] , 34 , from [ORGANIZATION: u'Hartpury/NNP']
[PERSON: u'John/NNP Bourn/NNP'] , head of the [ORGANIZATION: u'NAO/NNP']
[PERSON: u'Andrew/NNP Hogg/NNP'] , spokesman for the [ORGANIZATION: u'Medical/NNP Foundation/NNP']
[PERSON: u'Veritas/NNP'] ' deputy leader . [ORGANIZATION: u'UKIP/NNP']
[PERSON: u'Tony/NNP Beddow/NNP'] , from the [ORGANIZATION: u'Welsh/NNP Institute/NNP']
[PERSON: u'Ieuan/NNP Wyn/NNP Jones/NNP'] , leader of the [ORGANIZATION: u'Plaid/NNP Cymru/NNP']
[PERSON: u'Simon/NNP Sweetman/NNP'] , from the [ORGANIZATION: u'Federation/NNP']
[PERSON: u'Hutu/NNP'] leader . The five-year [ORGANIZATION: u'Department/NNP']
[PERSON: u'Kayitesi/NNP Blewitt/NNP'] , founder of the [ORGANIZATION: u'Survivors/NNPS Fund/NNP']
[PERSON: u'Galloway/NNP'] was expelled from the [ORGANIZATION: u'Labour/NNP']
[PERSON: u'Massoud/NNP Shadjareh/NNP'] , from the [ORGANIZATION: u'Muslim/NNP Safety/NNP Forum/NNP']
[PERSON: u'Mike/NNP'] Hobday , from the [ORGANIZATION: u'League/NNP Against/NNP Cruel/NNP Sports/NNP']
[PERSON: u'Neill/NNP'] , editor of union-backed [ORGANIZATION: u'Hazards/NNP']
[PERSON: u'David/NNP Rose/NNP'] , Chief Executive of [ORGANIZATION: u'Hereford/NNP Hospitals/NNP']
[PERSON: u'Bob/NNP Neill/NNP'] , leader of the [ORGANIZATION: u'London/NNP Assembly/NNP Conservatives/NNPS']
[PERSON: u'Winston/NNP Churchill/NNP'] told us - from the [ORGANIZATION: u'Baltic/NNP']
[PERSON: u'Veritas/NNP'] ' deputy leader . [ORGANIZATION: u'UKIP/NNP']
[PERSON: u'Veritas/NNP'] ' deputy leader . [ORGANIZATION: u'UKIP/NNP']
[PERSON: u'Graham/NNP Lane/NNP'] , leader of the [ORGANIZATION: u'Labour/NNP']
[PERSON: u'Carl/NNP Emerson/NNP'] , from the [ORGANIZATION: u'Institute/NNP']
[PERSON: u'Maeve/NNP Sherlock/NNP'] , chief executive of the [ORGANIZATION: u'Refugee/NNP Council/NNP']
[PERSON: u'Adams/NNP'] , from the [ORGANIZATION: u'UK/NNP']
[PERSON: u'Anne/NNP Weyman/NNP'] , chief executive of the [ORGANIZATION: u'Family/NNP']
===== Relations of PERSON and PERSON =====
```

¹<https://github.com/saikiran638/MyProjects/tree/master/FinalYearProject>

[PERSON: u'Blunkett/NNP'] 's ex-lover 's nanny . [PERSON: u'Sir/NNP']
 [PERSON: u'Pound/NNP'] said his wife [PERSON: u'Maggie/NNP']
 [PERSON: u'Sandra/NNP'] , daughter [PERSON: u'Larissa/NNP']
 ===== Relations of PERSON and LOCATION =====
 [PERSON: u'Neil/NNP Coppendale/NNP'] , from [LOCATION: u'West/NNP Sussex/NNP']
 [PERSON: u'Welsh/NNP'] , was born in [GPE: u'Melbourne/NNP']
 [PERSON: u'Andrew/NNP Elliot/NNP'] , 42 , from [GPE: u'Bromesberrow/NNP']
 [PERSON: u'Richard/NNP Wakeham/NNP'] , 34 , from [GPE: u'York/NNP']
 [PERSON: u'Budget/NNP Chancellor/NNP Gordon/NNP Brown/NNP'] will deliver his [GPE: u'Budget/NNP']
 [PERSON: u'Michael/NNP Ferguson/NNP'] to be released unescorted from [GPE: u'Carstairs/NNP']
 [PERSON: u'Nick/NNP Griffin/NNP'] - who lives near [GPE: u'Welshpool/NNP']
 [PERSON: u'Terry/NNP Griffiths/NNP'] , like Mr Howard from [GPE: u'Llanelli/NNP']
 [PERSON: u'Feroz/NNP Abbasi/NNP'] , from [GPE: u'London/NNP']
 [PERSON: u'Feroz/NNP Abbasi/NNP'] , from [GPE: u'London/NNP']
 [PERSON: u'Tony/NNP Blair/NNP'] seems to have disappeared from [GPE: u'Labour/NNP']
 [PERSON: u'Labour/NNP'] on issues from [GPE: u'Iraq/NNP']
 [PERSON: u'Budget/NNP Chancellor/NNP Gordon/NNP Brown/NNP'] will deliver his [GPE: u'Budget/NNP']
 [PERSON: u'Brown/NNP'] was born in [GPE: u'Glasgow/NNP']
 ===== Relations related to DISTANCE =====

The relation extraction results for BBC business news:

===== Relations of PERSON and ORGANIZATION =====
 [PERSON: u'Yukos/NNP'] ' owner [ORGANIZATION: u'Menatop/NNP Group/NNP']
 [PERSON: u'Paul/NNP Sheard/NNP'] , economist at [ORGANIZATION: u'Lehman/NNP Brothers/NNPS']
 [PERSON: u'Rick/NNP Egelton/NNP'] , deputy chief economist at [ORGANIZATION: u'BMO/NNP']
 [PERSON: u'Sri/NNP Mulyani/NNP Indrawati/NNP'] , State Minister for [ORGANIZATION: u'National/NNP Development/NNP']
 [PERSON: u'David/NNP Naude/NNP'] , economist at [ORGANIZATION: u'Deutsche/NNP Bank/NNP']
 [PERSON: u'Hannes/NNP Wittig/NNP'] , telecoms analyst at [ORGANIZATION: u'Dresdner/NNP Kleinwort/NNP Wasserstein/NNP']
 [PERSON: u'Ed/NNP Silliere/NNP'] , analyst at [ORGANIZATION: u'Energy/NNP Merchant/NNP']
 [PERSON: u'Takashi/NNP Yamanaka/NNP'] , an economist with [ORGANIZATION: u'UFJ/NNP Bank/NNP']
 [PERSON: u'Norbert/NNP Reithofer/NNP'] , a member of the [ORGANIZATION: u'BMW/NNP']
 [PERSON: u'Brad/NNP Wernle/NNP'] , from [ORGANIZATION: u'Automotive/JJ News/NNP Europe/NNP']
 [PERSON: u'Simon/NNP Wheatley/NNP'] , from [ORGANIZATION: u'Goldman/NNP Sachs/NNP']
 [PERSON: u'Bill/NNP Armstrong/NNP'] , a retail analyst at [ORGANIZATION: u'CL/NNP']
 [PERSON: u'Patrick/NNP Juchemich/NNP'] , auto analyst at [ORGANIZATION: u'Sal/NNP Oppenheim/NNP Bank/NNP']
 [PERSON: u'Stuart/NNP Quint/NNP'] , an analyst at [ORGANIZATION: u'Gartmore/NNP']
 [PERSON: u'James/NNP Carrick/NNP'] , an economist with [ORGANIZATION: u'ABN/NNP Amro/NNP']
 [PERSON: u'Michael/NNP Blythe/NNP'] , chief economist at the [ORGANIZATION: u'Commonwealth/NNP Bank/NNP']
 [PERSON: u'Hiromichi/NNP Shirakawa/NNP'] , chief economist at [ORGANIZATION: u'UBS/NNP Securities/NNPS']
 [PERSON: u'Arjan/NNP Sweere/NNP'] , an analyst at [ORGANIZATION: u'Petercam/NNP']
 [PERSON: u'Heronry/NNP Nozaki/NNP'] , an analyst at [ORGANIZATION: u'NikkoCitigroup/NNP']
 [PERSON: u'Michael/NNP Rabb/NNP'] , an analyst with [ORGANIZATION: u'Bank/NNP Sal/NNP Oppenheim/NNP']
 [PERSON: u'Avery/NNP Shenfeld/NNP'] , senior economist at [ORGANIZATION: u'CIBC/NNP World/NNP Markets/NNPS']
 [PERSON: u'James/NNP Tambone/NNP'] , who it says headed [ORGANIZATION: u'CFD/NNP']
 [PERSON: u'Arne/NNP Kristiansen/NNP'] , a spokesman for the [ORGANIZATION: u'Danish/NNP Dairy/NNP Board/NNP']
 [PERSON: u'Richard/NNP Jeffrey/NNP'] , chief economist at [ORGANIZATION: u'Bridgewell/NNP Securities/NNPS']
 [PERSON: u'Libya/NNP'] 's oil minister , told [ORGANIZATION: u'Reuters/NNP']
 [PERSON: u'John/NNP Palmer/NNP'] , political director at the [ORGANIZATION: u'European/JJ Policy/NNP Centre/NNP']
 [PERSON: u'Libya/NNP'] 's oil minister , told [ORGANIZATION: u'Reuters/NNP']
 [PERSON: u'Jonathan/NNP Loynes/NNP'] , chief UK economist at [ORGANIZATION: u'Capital/NNP Economics/NNP']
 [PERSON: u'Lebedev/NNP'] headed the [ORGANIZATION: u'Menatop/NNP']
 [PERSON: u'Paul/NNP Cherney/NNP'] , chief market analyst at [ORGANIZATION: u'Standard/NNP']
 [PERSON: u'Gary/NNP Thayer/NNP'] , an economist at [ORGANIZATION: u'AG/NNP Edwards/NNP']
 [PERSON: u'Robert/NNP Brusca/NNP'] , chief economist at [ORGANIZATION: u'Fact/NNP']
 [PERSON: u'Anais/NNP Faraj/NNP'] , an analyst at [ORGANIZATION: u'Nomura/NNP']
 [PERSON: u'Marc/NNP Touati/NNP'] , an economist at [ORGANIZATION: u'Natexis/NNP Banques/NNP Populaires/NNP']
 [PERSON: u'Helmut/NNP Schneider/NNP'] , director of the [ORGANIZATION: u'Institute/NNP']
 [PERSON: u'Marc/NNP Toutai/NNP'] , an economist at [ORGANIZATION: u'Natexis/NNP Banques/NNP Populaires/NNP']
 [PERSON: u'Nicolas/NNP Claquin/NNP'] , an analyst at [ORGANIZATION: u'CCF/NNP']
 [PERSON: u'David/NNP Graham/NNP'] from the [ORGANIZATION: u'FDA/NNP']
 [PERSON: u'Deutsche/NNP Boerse/NNP'] investors unhappy with its [ORGANIZATION: u'London/NNP Stock/NNP Exchange/NNP']
 [PERSON: u'Paul/NNP Richards/NNP'] , an analyst at [ORGANIZATION: u'Numis/NNP Securities/NNPS']
 [PERSON: u'Wallace/NNP Cheung/NNP'] , an analyst at [ORGANIZATION: u'DBS/NNP Vickers/NNP']
 [PERSON: u'David/NNP Cummings/NNP'] , head of [ORGANIZATION: u'UK/NNP']
 [PERSON: u'John/NNP Reade/NNP'] , an analyst at [ORGANIZATION: u'UBS/NNP']
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[PERSON: u'Suhas/NNP Naik/NNP'] , an investment analyst from [ORGANIZATION: u'ING/NNP Mutual/NNP Fund/NNP']
[PERSON: u'Reza/NNP Moghadam/NNP'] , assistant director of the [ORGANIZATION: u'IMF/NNP']
[PERSON: u'Michael/NNP Deppler/NNP'] , director of the [ORGANIZATION: u'IMF/NNP']
[PERSON: u'Axa/NNP'] spokesman , told [ORGANIZATION: u'BBC/NNP News/NNP']
[PERSON: u'Tim/NNP Congdon/NNP'] , economist at [ORGANIZATION: u'ING/NNP Barings/NNP']
[PERSON: u'Michael/NNP Moran/NNP'] , analyst at [ORGANIZATION: u'Daiwa/NNP Securities/NNPS']
[PERSON: u'Kurt/NNP Karl/NNP'] , economist at [ORGANIZATION: u'Swiss/NNP Re/NNP']
[PERSON: u'Kerry/NNP'] to release supplies from the [ORGANIZATION: u'US/NNP']
[PERSON: u'Ivo/NNP Geijsen/NNP'] , an analyst with [ORGANIZATION: u'Bank/NNP Oyens/NNP']
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[PERSON: u'Ronald/NNP Smith/NNP'] , an analyst at [ORGANIZATION: u'Renaissance/NNP Capital/NNP']
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[PERSON: u'Card/NNP'] 's creditors have given [ORGANIZATION: u'LG/NNP']
[PERSON: u'Lynn/NNP Franco/NNP'] , director of the [ORGANIZATION: u'Conference/NNP Board/NNP']
[PERSON: u'Marc/NNP Gonsalves/NNP'] , an executive at [ORGANIZATION: u'Xstrata/NNP']
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[PERSON: u'Wangli/NNP'] , a spokesman for the [ORGANIZATION: u'State/NNP Tobacco/NNP Administration/NNP Monopoly/NNP']
[PERSON: u'Stefan/NNP Schilbe/NNP'] , analyst at [ORGANIZATION: u'HSBC/NNP Trinkaus/NNP']
[PERSON: u'John/NNP Nettle/NNP'] , a former employee of [ORGANIZATION: u'General/NNP Mills/NNP']
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[PERSON: u'Simon/NNP Rubinsohn/NNP'] , chief economist at [ORGANIZATION: u'Gerrard/NNP']
[PERSON: u'Frank/NNP Brown/NNP'] , global advisory leader at [ORGANIZATION: u'PwC/NNP']
===== Relations of PERSON and PERSON =====
[PERSON: u'Viktor/NNP Pinchuk/NNP'] , son-in-law of former-President [PERSON: u'Leonid/NNP Kuchma/NNP']
[PERSON: u'Glazer/NNP'] 's two sons , [PERSON: u'Avi/NNP']
[PERSON: u'Viktor/NNP Pinchuk/NNP'] , son-in-law of former-President [PERSON: u'Kuchma/NNP']
[PERSON: u'Glazer/NNP'] 's two sons , [PERSON: u'Avi/NNP']
===== Relations of PERSON and LOCATION =====
[PERSON: u'Money/NN'] has moved out from [GPE: u'India/NNP']
[PERSON: u'Bruce/NNP Misamore/NNP'] lives in [GPE: u'Houston/NNP']
[PERSON: u'Joshua/NNP Osagie/NNP'] , a cocoa farmer from [GPE: u'Edo/NNP']
[PERSON: u'Sergei/NNP Bogdanchikov/NNP'] . According to reports from [GPE: u'Russian/JJ']
[PERSON: u'Alvarez/NNP'] added . Companies from the [GPE: u'United/NNP States/NNPS']
[PERSON: u'Nanik/NNP Rupani/NNP'] , president of the [GPE: u'Indian/JJ']
[PERSON: u'Helen/NNP Carroll/NNP'] , from [GPE: u'Portsmouth/NNP']
[PERSON: u'Sandy/NNP Oatley/NNP'] have both resigned from [GPE: u'Southcorp/NNP']
[PERSON: u'Mauritius/NNP'] and one from [GPE: u'Malaysia/NNP']
[PERSON: u'Siena/NNP'] , both from [GPE: u'Italy/NNP']
===== Relations related to DISTANCE =====

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. More importantly the total performance directly depends on the **taggers** we are using for parts of speech tagging and noun phrase chunking. It is better to take taggers those performs well.

5.2 Future Work

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

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

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