# Morpho-syntactic Analysis with the Stanford CoreNLP

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# Objectives of this tutorial

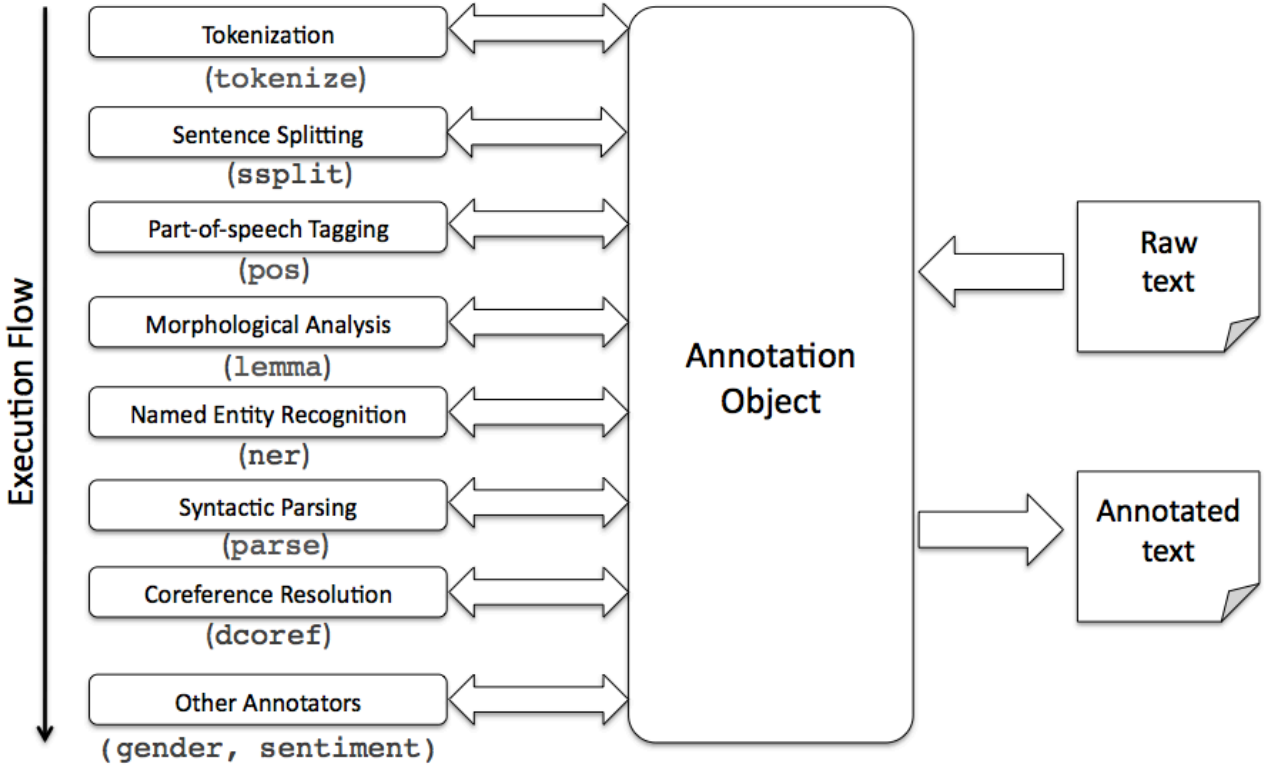
- Use of a Natural Language Toolkit
  - CoreNLP toolkit
- Morpho-syntactic analysis of short texts
  - Tokenization
  - Part-of-speech Tagging
  - Lemmatization
  - Named Entity Recognition
  - Dependency Parsing
- Use of such body of linguistic evidence for a task
  - Knowledge Acquisition by reading large scale corpora

# The Stanford CoreNLP

- The Stanford CoreNLP is a statistical natural language parser from the Stanford Natural Language Processing Group.
  - Used to parse input data written in several languages
    - such as English, German, Arabic and Chinese
- it has been developed and maintained since 2002, from the Stanford University
  - Written in Java
  - The application is licensed under the GNU GPL, but commercial licensing is also available.
- Site: `http://stanfordnlp.github.io/CoreNLP/`
- A demo is available at: `http://corenlp.run/`

# Stanford CoreNLP

- The list of processors



# An example

- Let us consider the sentence:
  - *"In 1982, Mark drove his car from Los Angeles to Las Vegas."*

**Part-of-Speech:**

| | IN | CD | , | NNP | VBD | PRP$ | NN | IN | NNP | NNP | TO | NNP | NNP | . |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | In | 1982 | , | Mark | drove | his | car | from | Los | Angeles | to | Las | Vegas | . |

**Lemmas:**

| | in | 1982 | , | Mark | drive | he | car | from | Los | Angeles | to | Las | Vegas | . |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | In | 1982 | , | Mark | drove | his | car | from | Los | Angeles | to | Las | Vegas | . |

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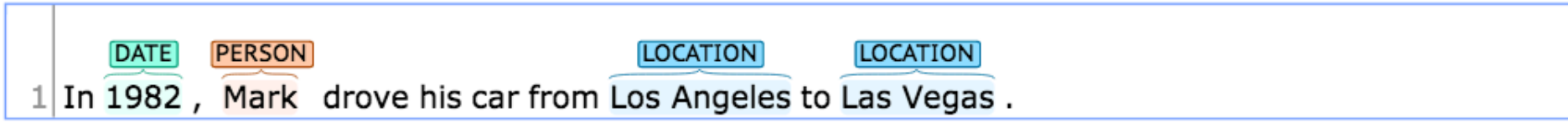
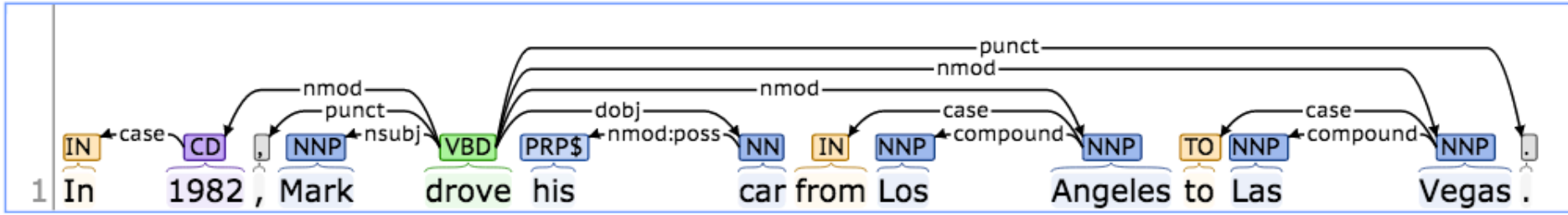
**Named Entity Recognition:**




**Basic Dependencies:**



# How to use from Java

- It can be easily integrated in a Java project that support Maven, adding the following dependency to the pom.xml file

```
<dependencies>
        <dependency>
                <groupId>edu.stanford.nlp</groupId>
                <artifactId>stanford-corenlp</artifactId>
                <version>3.6.0</version>
        </dependency>
        <dependency>
                <groupId>edu.stanford.nlp</groupId>
                <artifactId>stanford-corenlp</artifactId>
                <version>3.6.0</version>
                <classifier>models</classifier>
        </dependency>
</dependencies>
```

# A small example in JAVA

```
We see here how to parse a sentence and write on

// The Properties object contains the list of processors to be loaded
Properties props = new Properties();
props.put("annotators", "tokenize, ssplit, pos, lemma, ner, parse");

// Intializing the StanfordCoreNLP toolkit
```

StanfordCoreNLP pipeline = **new StanfordCoreNLP(props)**;
String str = "In 1982, Mark drove his car from Los Angeles to Las Vegas";

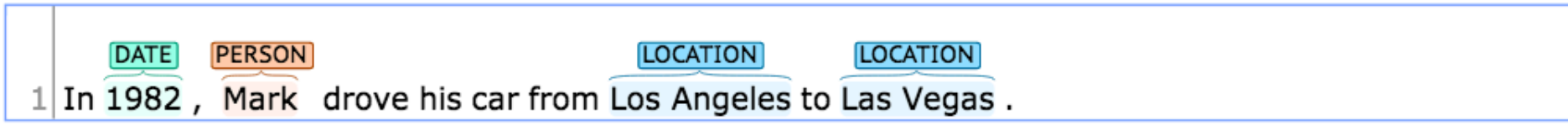
# The CONLL format

```
Annotation document = new Annotation(str);
pipeline.annotate(document);
List<CoreMap> sentences = document.get(SentencesAnnotation.class);
// for each sentence
for (CoreMap sentence : sentences) {
          // Extract the dependency graph
          SemanticGraph dependencies = sentence.get(BasicDependenciesAnnotation.class);
          // For each token
          for (CoreLabel token : sentence.get(TokensAnnotation.class)) {
                    IndexedWord sourceNode = dependencies.getNodeByIndex(token.index());
                    IndexedWord father = dependencies.getParent(sourceNode);
                    // If no father is available, the token is associated to the "root" node
                    int fatherId = 0;
                    String relName = "root";
                    if (father != null) {
                              fatherId = father.index();
                              SemanticGraphEdge edge=dependencies.getEdge(father,sourceNode);
                              relName = edge.getRelation().getShortName();
                    }
                    System.out.println(token.index() + "\t" + token.originalText() +
                              "\t" + token.lemma() + "\t" + token.tag()+ "\t" +
                              token.ner() + "\t" + relName + "\t" + fatherId);
          }
          System.out.println();
}
```

# The CONLL tabular format

| Token ID | Surface | Lemma | POS | Namend Entity | Relation Name | Dependant |
|---|---|---|---|---|---|---|
| 1 | In | in | IN | O | case | 2 |
| 2 | 1982 | 1982 | CD | DATE | nmod | 5 |
| 3 | , | , | , | O | punct | 5 |
| 4 | Mark | Mark | NNP | PERSON | nsubj | 5 |
| 5 | drove | drive | VBD | O | root | 0 |
| 6 | his | he | PRP$ | O | nmod:poss | 7 |
| 7 | car | car | NN | O | dobj | 5 |
| 8 | from | from | IN | O | case | 10 |
| 9 | Los | Los | NNP | LOCATION | compound | 10 |
| 10 | Angeles | Angeles | NNP | LOCATION | nmod | 5 |
| 11 | to | to | TO | O | case | 13 |
| 12 | Las | Las | NNP | LOCATION | compound | 13 |
| 13 | Vegas | Vegas | NNP | LOCATION | nmod | 5 |
| 14 | . | . | . | O | punct | 5 |

**Named Entity Recognition:**



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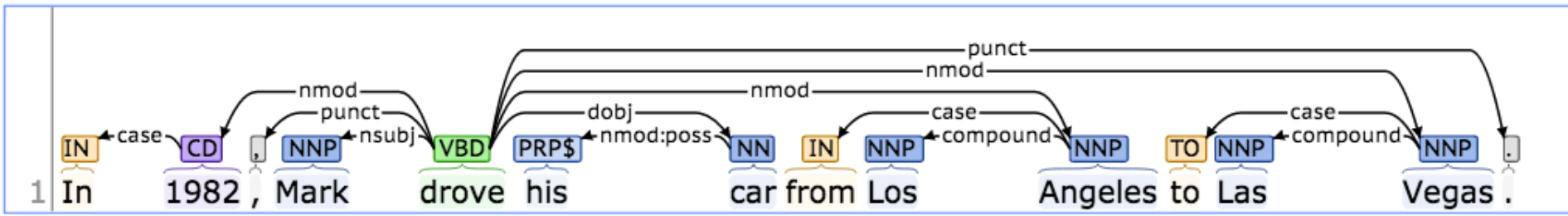

# Final objective of this exercitation

- Let us try to navigate the parse tree
- It will provide a first form of Ontology Learning by exploiting Syntactic information
  - Acquiring simple facts from the automatic analysis of large scale corpora, e.g.

```
PERSON – marry - PERSON
```

- We will extract morpho-syntactic parser in the form

```
Subject – VERB – Direct Object
```

- We need a large-scale corpus already processed with CoreNLP

# You will be provided with…

- A "small" selection of abstracts from Wikipedia processed with CoreNLP, already in CONLL format
  - 375K sentences
  - 9.6M of tokens
- A python script (`CoreNLP_simple_reader.py`) to
  - load the processed sentences stored as textual files in the CONLL format
  - navigate the resulting dependency graph
  - extract simple information

# Exercise

1. Extract and count the occurrences of Nouns in the provided corpus
   - The list of Part-of-speech tags is provided here:

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

2. Extract and count the occurrences of mentions to Named Entities in the provided corpus
   - Focus on the `PERSON` category

# Exercise (2)

3. Extract and count all patterns in the form

```
Noun – nsubj – Verb – dobj – Noun
```

keeping the lemma of the involved nouns / verbs, e.g.,

```
Mark -      drive  -      car
```

4. Extract and count all patterns in the form extracted at step 3, but replace the Named Entities with their types

```
PERSON      -      drive  -      car
```

The complete list of existing dependency can be found here:

`http://nlp.stanford.edu/pubs/USD_LREC14_paper_camera_ready.pdf`

# Useful Links

- CoreNLP Web Page:
  - `http://stanfordnlp.github.io/CoreNLP/`
- How to Download the last version of CoreNLP:
  - `http://nlp.stanford.edu/software/stanford-corenlp-full-2015-12-09.zip`
- Demo
  - `http://corenlp.run/`
- A description of CoreNLP:
  - `http://nlp.stanford.edu/pubs/StanfordCoreNlp2014.pdf`

# Alphabetical list of POS tags used in the Penn Treebank Project

| Tag | Description | Tag | Description |
|---|---|---|---|
| CC | Coordinating conjunction | PRP$ | Possessive pronoun |
| CD | Cardinal number | RB | Adverb |
| DT | Determiner | RBR | Adverb, comparative |
| EX | Existential there | RBS | Adverb, superlative |
| FW | Foreign word | RP | Particle |
| IN | Preposition or subordinating conjunction | SYM | Symbol |
| JJ | Adjective | TO | to |
| JJR | Adjective, comparative | UH | Interjection |
| JJS | Adjective, superlative | VB | Verb, base form |
| LS | List item marker | VBD | Verb, past tense |
| MD | Modal | VBG | Verb, gerund or present participle |
| NN | Noun, singular or mass | VBN | Verb, past participle |
| NNS | Noun, plural | VBP | Verb, non-3rd person singular present |
| NNP | Proper noun, singular | VBZ | Verb, 3rd person singular present |
| NNPS | Proper noun, plural | WDT | Wh-determiner |
| PDT | Predeterminer | WP | Wh-pronoun |
| POS | Possessive ending | WP$ | Possessive wh-pronoun |
| PRP | Personal pronoun | WRB | Wh-adverb |