

10 – Automatic relation extraction

IA161 Advanced Techniques of Natural Language Processing

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December 10, 2020

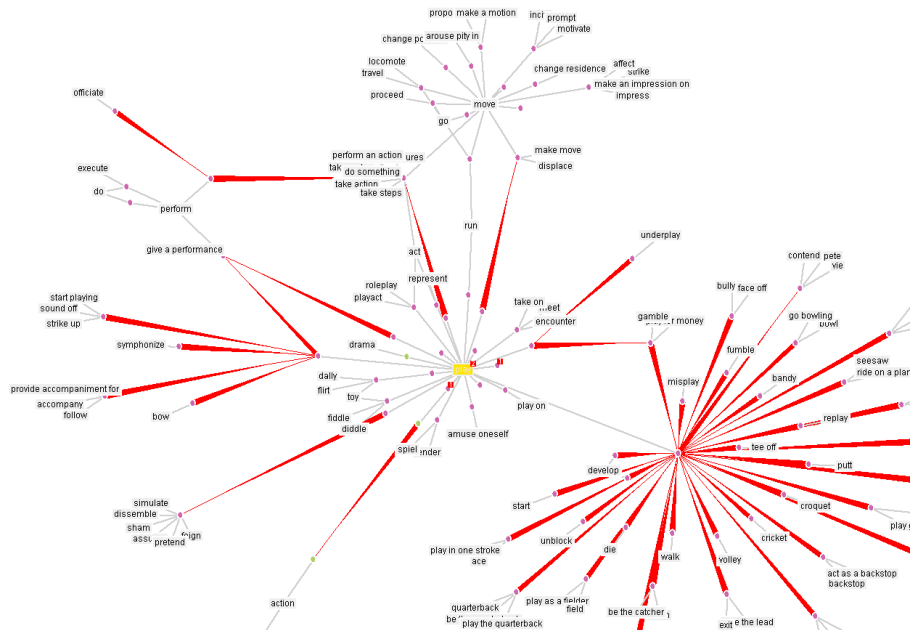
1 Introduction

2 Extraction

- Pattern-based approach
- Distributional approach
- Neural networks

3 Evaluation

Automatic relation extraction



Semantic Networks

- network representing *relations between concepts*
- *knowledge graph*
- WordNet – lexical database of English
 - ▶ synsets, main relation hyponymy/hypernymy, meronymy, synonymy, antonymy. . .
 - ▶ Multilingual Wordnet network

Why would you do that?

- semantic analysis (house → home, music, MD?)
- query expansion (dog → poodle, terrier...)
- lexical substitution (match → game)
- machine translation
- question answering
- domain classification (lemon, apple, banana → fruit)
- summarization
- paraphrase

Example

Human illuminates Document

AG[bird:1] VERB sezobnout SUBS[feed:1]

What do we need?

- morphological tags
- syntactic analysis (phrases)
- dataset (dictionary, corpus, Wikipedia...)

Pattern recognition

regular expression to match Part-of-Speech and text

Example

NP {,} especially {NP, }* {or |and} NP

...most *European countries*, especially *France*, *England*, and *Spain*.

European country >France

European country >England

European country >Spain

Example

e.g. {NP,}* {and |or} NP.

...e.g. apples, bananas, or pears.

related terms

Example

NP such as {NP, }* {and |or} NP

common *domestic animals* such as the *ferret* and the *fancy rat*

domestic animal >ferret

domestic animal >(fancy) rat

in areas with a long history of *mining* such as *South-west England*

mining >South-west England

in *areas* (with a long history of mining) such as *South-west England*

area >South-west England

- remove stopwords
- detect optional adjunct phrases
- detect named entities

| No. | Pattern | Number of occurrences | Number of relevant occurrences | Intermediary precision (%) |
|-----|---------------|-----------------------|--------------------------------|----------------------------|
| 1. | other than | 168 | 164 | 97.6 |
| 2. | especially | 120 | 90 | 75 |
| 3. | principally | 11 | 6 | 54.5 |
| 4. | usually | 18 | 14 | 77.8 |
| 5. | such as | 2470 | 1950 | 78.9 |
| 6. | in particular | 78 | 48 | 61.5 |
| 7. | e(.)g(.) | 280 | 216 | 77.1 |
| 8. | become | 780 | 510 | 66.7 |
| 9. | another | 92 | 72 | 78.3 |
| 10. | notably | 76 | 42 | 55.3 |
| 11. | particularly | 130 | 80 | 61.5 |
| 12. | except | 13 | 4 | 30.8 |
| 13. | called | 270 | 220 | 81.5 |
| 14. | like | 1600 | 1300 | 81.3 |
| 15. | including | 670 | 430 | 64.2 |

Corpus query

- special case of pattern recognition, CQL query
- bigger data at hand, less options

Example

je/jsou

```
2: [k="k1"&c="c1"] ([lc=", " [k="k1"])*  
([lc="a"|lc="i"|lc="nebo"|lc="či" [k="k1"])?  
[lemma_lc="být"&tag="k5eAaImIp3.*"&lc!="ne.*"]  
([k="k1"&c="c[1246]" [k="k2"]{0,2})?  
1: [k="k1"&c="c[1246]"
```

experiment on domain dictionary: precision 40%, when limited to dictionary terms 52%

Multilingual translation

using translation equivalents from multilingual dictionary to provide synonyms

Example

stůl = table

table = stůl, stolek

stůl = stolek

Synonym transitivity

- expanding relations based on existing relations (transitive closure)

Example

city = town, town = municipality

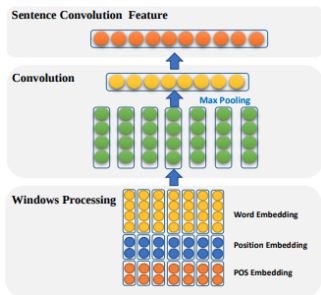
⇒ city = municipality

Distributional approach

- vector space model
- word-context frequency matrix
- clustering
- similar context \neq synonym
- e.g. Sketch Engine thesaurus

Neural networks

- word embeddings
- position embeddings – relative distance between words
- part of speech embeddings – tag PoS for each word
- WordNet information may help
- combine properties to get relations between entities in sentence



| Relation | Representation of Word Attention Weight |
|-------------------|--|
| Instrument-Agency | The author of a keygen uses a disassembler to look at the raw assembly code |
| Message-Topic | The Pulitzer Committee issues an official citation explaining the reasons for the award |
| Cause-Effect | The burst has been caused by water hammer pressure |
| Instrument-Agency | Even commercial networks have moved into high-definition broadcast |
| Component-Whole | The girl showed a photo of apple tree blossom on a fruit tree in the Central Valley |
| Member-Collection | They tried an assault of their OWN an hour later, with two columns of sixteen tanks backed by a battalion of Panzer grenadiers |

TOEFL test evaluation

- evaluation by solving TOEFL synonym test
- Choose synonym for *fabricate*.
 - ▶ construct, alter, select, demonstrate
- build synonym set for each word
- detect overlap
- success rate 88 %

- various tasks evaluating computational semantic analysis systems
- human annotators provide *gold standards*
- NLP systems are evaluated
- tasks include Word Sense Disambiguation, Machine Translation, Information Extraction, Learning Semantic Relations. . .

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