

Temporal Role Annotation for Named Entities

Maria Koutraki, Farshad Bakhshandegan-Moghaddam, Harald Sack
Vienna, 13.9.2018

What is a role?

“the position or purpose that someone or something has in a situation, organization, society, or relationship”¹

- A role is a position
- Anything (in particular *named entities*) can take over a role

A role is not a named entity, refers to a named entity!

ROLE	PERSON	LOCATION
The Pope	asked Michelangelo,	when the Sistine Chapel ceiling will be ready.

Refers to



Julius II

¹ Cambridge dictionary

What is a role?

“the position or purpose that someone or something has in a situation, organization, society, or relationship”¹

- A role is a position
- Anything (in particular *named entities*) can take over a role

A role is not a named entity, refers to a named entity!

ROLE

PERSON

LOCATION

The Pope asked Michelangelo, when the Sistine Chapel ceiling will be ready.

Categories:

- Permanent roles (e.g. human, mother, ...)
- **Temporal restricted roles** (e.g. CEO of a company, Pope, ...)

¹ Cambridge dictionary

More Motivation...

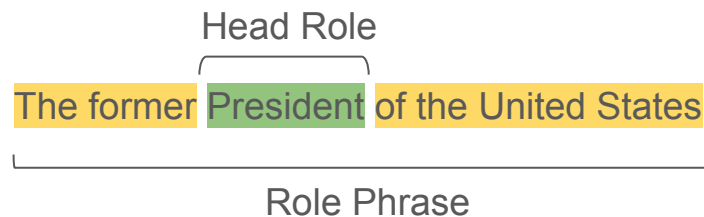
- Roles for entities in knowledge graphs are present for most entity types
- Roles represent pivotal information for an entity
- Roles are in abundance in unstructured textual resources
- Roles are highly sparse in existing KGs
- Roles are tied to specific temporal and contextual information

What are temporal restricted roles and how can we annotate them?

What is a temporal role?

- Roles that specify one or a few particular entities at a specific point in time
- A function which for a given a *temporal context* returns a *named entity* (or a few)!

- **Head Role:** Identifies the most general variant of a role with potentially high ambiguity
- **Role Phrase:** Specifies the role with sufficient details for the successful disambiguation.



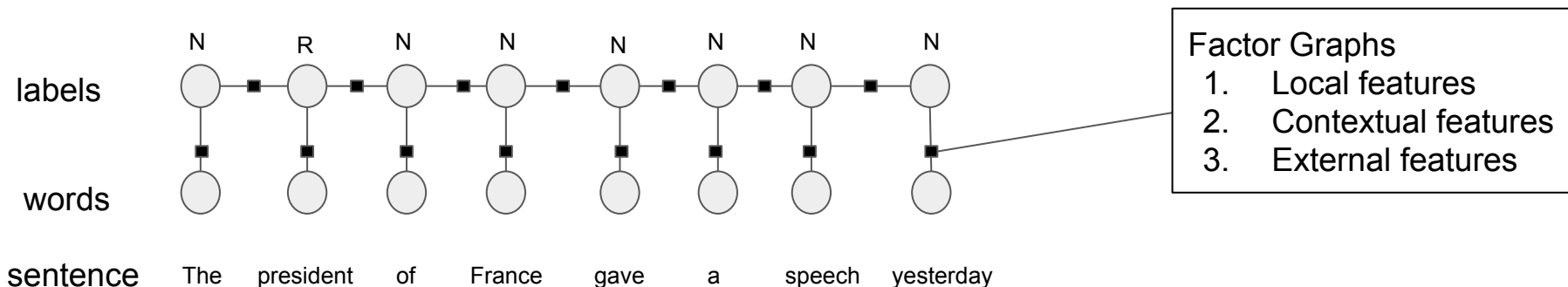
Objective - Temporal Role Annotation

Goal: Detect and annotate in an automatic way

- temporal roles and
- role phrases in natural language text

Approach - Head Role Annotator

- Automated approach → sequence classification
 - The roles are influenced by the preceding and succeeding words in a sentence
 - The relation between different segments in a sentence has impact in categorization
- Linear-chain CRF model:



Approach - Local Features

Take into account only the information from the individual words

id	Feature
f_1	w_i
f_2	$\text{POS}(w_i)$
f_3	$\text{NER}(w_i)$
f_4	$\text{startWithCapital}(w_i)$
f_5	$\text{fullyInCapital}(w_i)$
f_6	$\text{startOfSentence}(w_i)$
f_7	$\text{Lemma}(w_i)$

Example: *The president of France gave a speech yesterday*

Feature Values for $i=1$:

f_1 ="The", f_2 ="DT", f_3 ="null", f_4 ="true", f_5 ="false", f_6 ="true", f_7 ="the"

Feature Values for $i=2$:

f_1 ="president", f_2 ="noun", f_3 ="null", f_4 ="false", f_5 ="false", f_6 ="false", f_7 ="president"

Approach - Contextual Features

Capture the dependencies of a word w_i and its surrounding words $w_{i+2} \dots w_{i-2}$

id	Feature
f_{8-11}	$w_{i-2}, w_{i-1}, w_{i+1}, w_{i+2}$
f_{12-15}	$\text{POS}(w_{i-2}), \text{POS}(w_{i-1}),$ $\text{POS}(w_{i+1}), \text{POS}(w_{i+2})$
f_{16-19}	$\text{NER}(w_{i-2}), \text{NER}(w_{i-1}),$ $\text{NER}(w_{i+1}), \text{NER}(w_{i+2})$

Example: *The king in chess is the most important piece*

Feature Values for $i=2$:

$f_8 = \text{"null"}$, $f_9 = \text{"The"}$, $f_{10} = \text{"in"}$, $f_{11} = \text{"chess"}$

Approach - Contextual Features

Capture the dependencies of a word w_i and its surrounding words $w_{i+2} \dots w_{i-2}$

id	Feature
$f_{8-f_{11}}$	$w_{i-2}, w_{i-1}, w_{i+1}, w_{i+2}$
$f_{12-f_{15}}$	$POS(w_{i-2}), POS(w_{i-1}),$ $POS(w_{i+1}), POS(w_{i+2})$
$f_{16-f_{19}}$	$NER(w_{i-2}), NER(w_{i-1}),$ $NER(w_{i+1}), NER(w_{i+2})$

Exploit the commonalities in the language structure!

Example: *The president of France gave a speech yesterday*

Feature Values for $i=2$:

$f_{12} = \text{"null"}$, $f_{13} = \text{"DT"}$, $f_{14} = \text{"IN"}$, $f_{15} = \text{"NNP"}$

Approach - External Features

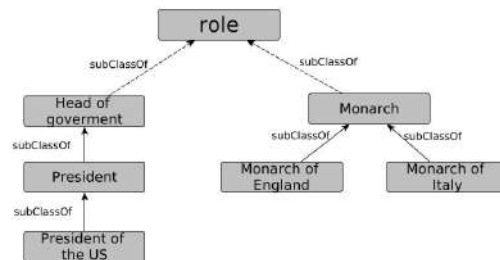
Use knowledge from external sources

id	Feature
f_{20}	$\text{isInDic}(w_i)$
f_{21}	$\text{LocalGrammar}(w_i)$

Boolean flag indicating if a token is part of a dictionary

Approach - External Features - Dictionary

- No existing dictionary dedicated to temporal roles
- Automatically construct a dictionary using knowledge graphs (Wikidata)
- Wikidata class *role*(Q214339) subtree:



- To ensure the temporal aspect of roles consider time-dependent properties (e.g. “*replaces*”, “*replaced by*”)

query:

```
SELECT DISTINCT ?role ?roleLabel WHERE {  
  ?role instanceOf*|subClassOf* wd:Q214339 .  
  ?role label ?roleLabel.  
  ?person positionHeld ?roleStatement.  
  ?roleStatement positionHeld ?role.  
  ?roleStatement replaces|replacedby ?differentRoleHolder.  
}
```

Approach - External Features

Use knowledge from external sources

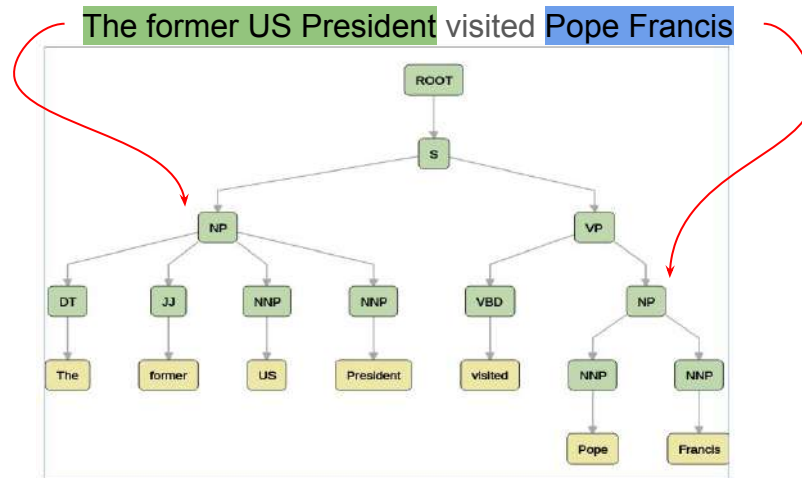
id	Feature
f_{20}	$isInDic(w_i)$
f_{21}	$LocalGrammar(w_i)$

- Boolean flag indicating if a token matches to a local grammar

Local Grammar	Samples
ROLE IN (POS) LOCATION (NER)	President of Iran, King of Egypt
ROLE PERSON (NER)	President Obama, Pope Francis
DT (POS) ROLE	The King, The Pope
ROLE IN (POS) ORGANIZATION (NER)	CEO of Apple
ORGANIZATION (NER) ROLE	Google CEO

Approach - Role Phrase Annotation

- Constituency Parse Tree
- Select nearest to the root Noun-Phrase



Experimental Setup (1/2)

- Tested Roles:
 - President, Pope, Monarch, CEO

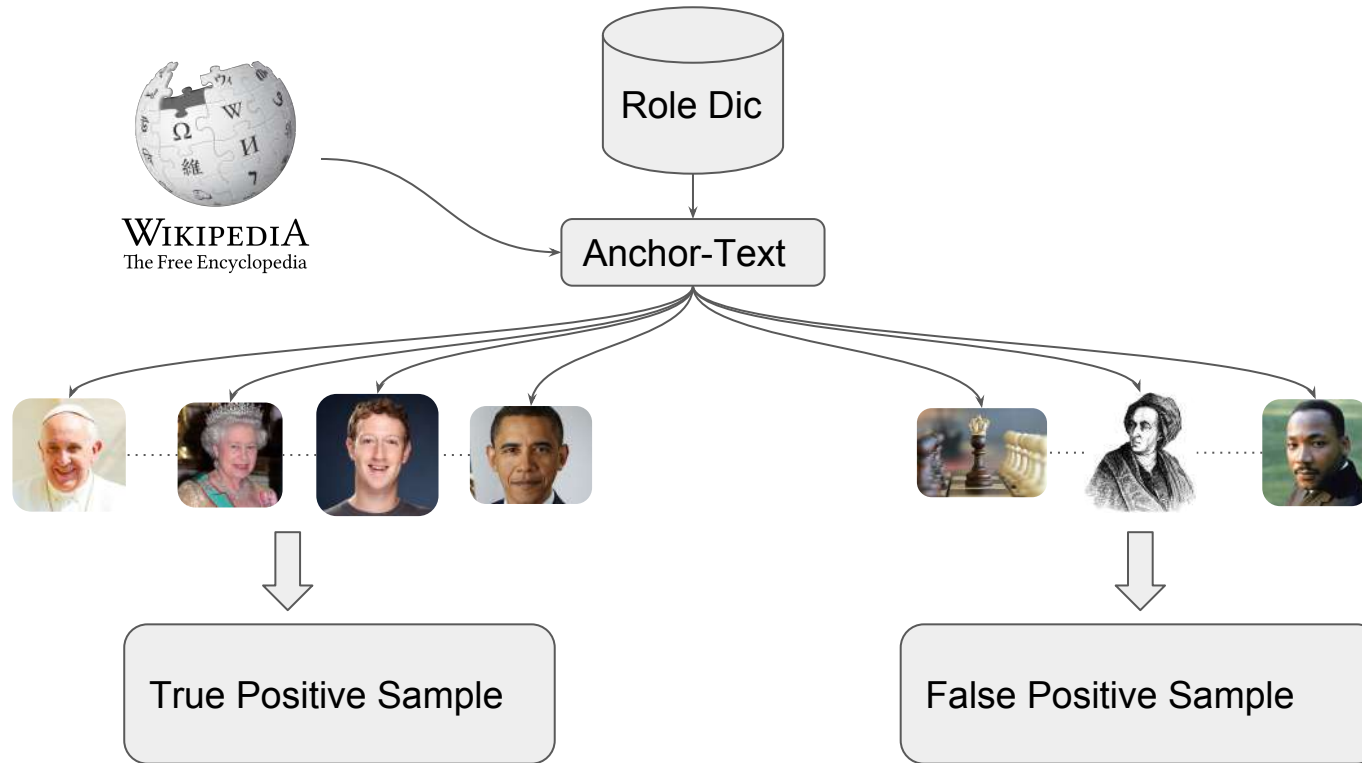
- Baselines:
 - Temporal Role Dictionary (>200 unique temporal role surfaces)
 - ANNIE job title gazetteer (>1.500 job titles)

Experimental Setup (2/2)

- Ground Truth:
 - Manually created dataset
 - New York Times corpus
 - 200 sentences
 - 64% True Positive 36% False Positive
 - Automatically generated dataset
 - Wikipedia articles

Sample	#tokens
True Positive	6M
False Positive	1.5M
True Negative	3.3M

Automatically generated GT Creation



Evaluation - Performance

- 5-fold cross validation over the automatically extracted dataset

Method	P	R	F ₁
Temp Role Dictionary	0.82	1	0.9
CRF-based Role Annotator	0.94	0.97	0.95

- The dictionary filters out the true negative samples but not the samples with ambiguous surface forms which may refer to a person name or a role (e.g. Pope)

Evaluation - Robustness

- Trained on the automatically extracted dataset (wikipedia) tested on the manually created dataset (New York Times)

Method	P	R	F ₁
Temp Role Dictionary	0.66	1	0.79
ANNIE Gazetteer	0.55	0.72	0.62
CRF-based Role Annotator	0.80	0.93	0.86

- Dictionary: Cannot differentiate the “Alexander Pope” and “Pope Francis”
- Role Annotator: learns patterns like “<PERSON> Pope” → Not a Role

Evaluation - Feature Ablation

- 5-fold cross validation over the automatically extracted dataset (Wikipedia)

Feature Group	P	R	F ₁
Local Features	0.90	0.95	0.92
Contextual Features	0.72	0.27	0.39
External Features	0.82	1	0.90
All Features	0.94	0.97	0.95
All Features (25% Dictionary size reduction)	0.94	0.92	0.93

Conclusion and Future Steps

- Definition of the task of temporal role annotation
- Proposed a structured prediction approach for the annotation of temporal roles
- Constructed two high quality ground-truth datasets for this task

- Next Steps
 - Experiment with more Role categories
 - Enrich the ground truth
 - Experiment with more features
 - Continue with the subsequent step of disambiguating the temporal roles to the corresponding named entities

Thank You!

Code and Data: <https://github.com/ISE-AIFB/RoleTagger>

Homepage: <https://www.fiz-karlsruhe.de/en/forschung/information-service-engineering/staff-ise/dr-maria-koutraki.html>

Email: maria.koutraki@fiz-karlsruhe.de, maria.koutraki@kit.edu

Twitter account: [@mairyl0u](https://twitter.com/mairyl0u)



Related Work

- NER
 - NER approaches are optimized to label surface forms that link to a NE class (PERSON, ORGANIZATION, PLACE...)
- NED/EL
 -
- Dictionaries and Gazetteers [1]
 - Domain dependent
 - Manual effort
 - Do not scale
 - Suffer in terms of recall

[1] Cunningham, H., Maynard, D., Bontcheva, K., Tablan, V., 2002. GATE: A Framework and Graphical Development Environment for Robust NLP Tools and Applications. ACL'02