



HAWK - Answering Boolean Hybrid Questions with HAWK

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Motivation

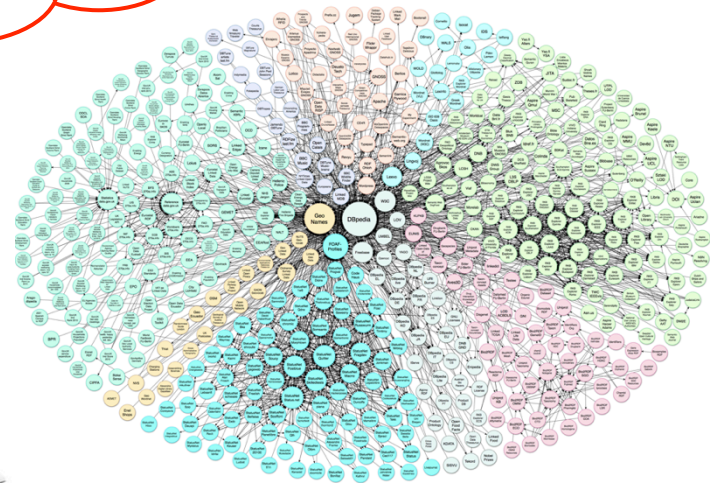
YAHOO!



Document Web



Did Napoleon's
first wife die in
France?



Linked Data Web

Motivation

Did Napoleon's first wife die in France?



Web

News

Bilder

Shopping

Videos

Mehr ▾

Suchoptionen

Ungefähr 2.410.000 Ergebnisse (0,43 Sekunden)

Napoleon - Wikipedia, the free encyclopedia

<https://en.wikipedia.org/wiki/Napoleon> ▾ Diese Seite übersetzen

Weiter zu **First Italian campaign** - Main article: Italian campaigns of the **French Revolutionary Wars** ... Two days after the **marriage**, Bonaparte left Paris to take command of ... I have learned nothing which I **did** not know at the beginning.

Joséphine de Beauharnais - Wikipedia, the free encyclopedia

https://en.wikipedia.org/.../Joséphine_de_Beauharna... ▾ Diese Seite übersetzen

Her marriage to **Napoleon I** was her second; her first husband Alexandre de ... Early life and **first marriage**; 2 Marriage to **Napoléon**; 3 Empress of the **French**; 4 Later on Saint Helena, that "I truly loved my Joséphine, but I **did** not respect her.

Napoleon - Emperor, Military Leader - Biography.com

www.biography.com/people/napoleon-9420291 ▾ Diese Seite übersetzen

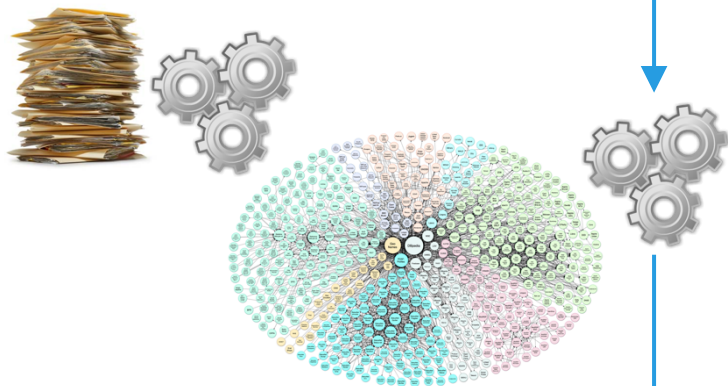
Napoleon Bonaparte, the first emperor of **France**, is regarded as one of the greatest military leaders in the ... **Napoleon - Mini Biography** (TV-PG; 3:35) **Napoleon Bonaparte** was born in 1769 in **France**. **Napoleon's** exile **did** not last long.



Hawk - Hybrid Question Answering

Query: Did Napoleon's first wife die in France?

User Query



Hybrid Question Answering Framework

Yes!

Hybrid Answer



Hawk - Hybrid Question Answering

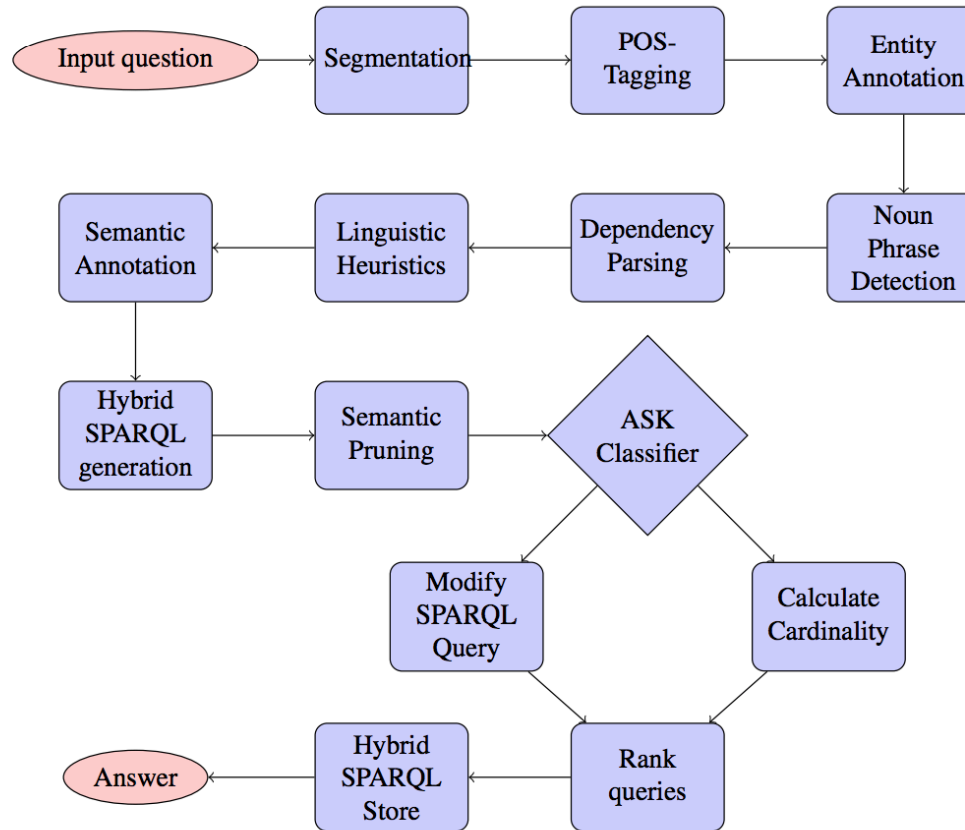


Fig. 1: Pipeline steps of HAWK.



Hawk - Hybrid Question Answering

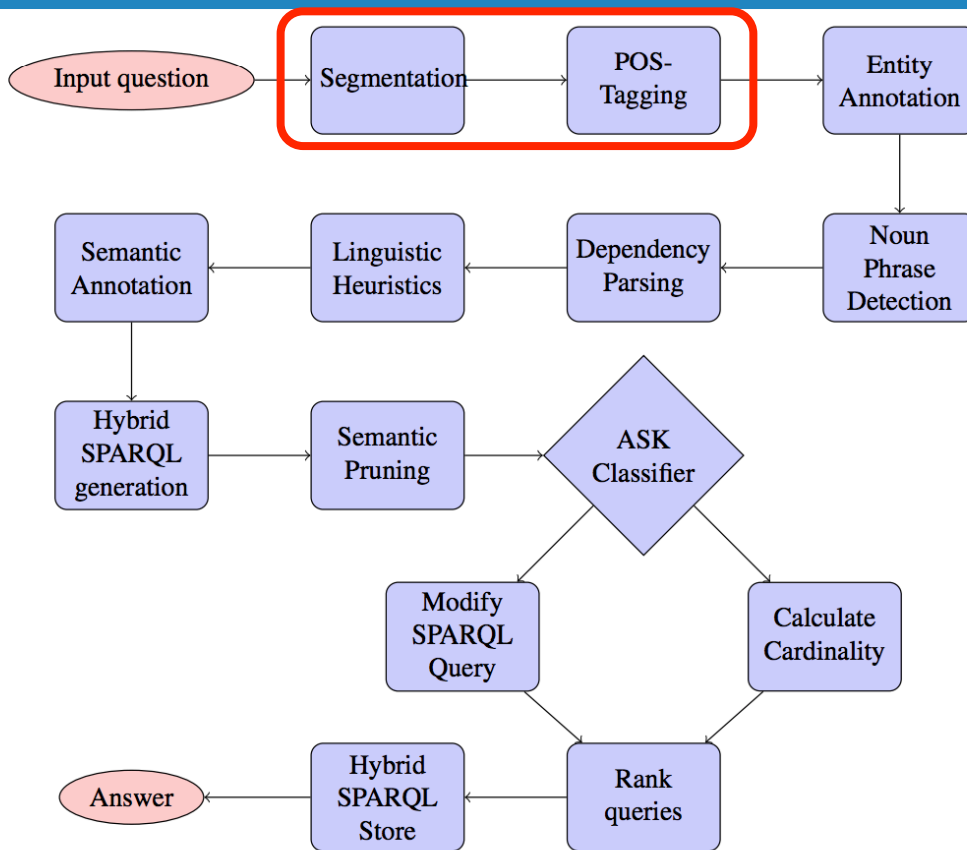


Fig. 1: Pipeline steps of HAWK.

Hawk -

POS Tagging / Segmentation

AKSW



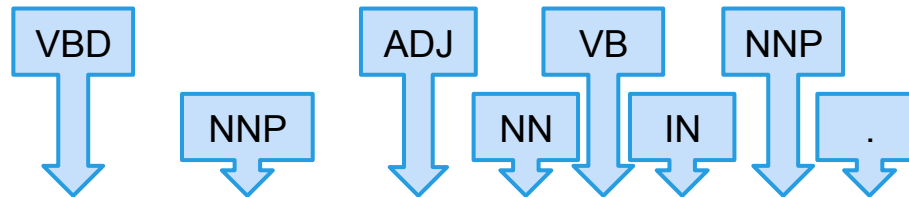
Query: Did Napoleon's first wife die in France?

- Powered by the ClearNLP API
- Segmentation based on WhiteSpace Tokenizer

Hawk -

POS Tagging / Segmentation

AKSW



Query: Did Napoleon's first wife die in France?

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Hawk - Hybrid Question Answering

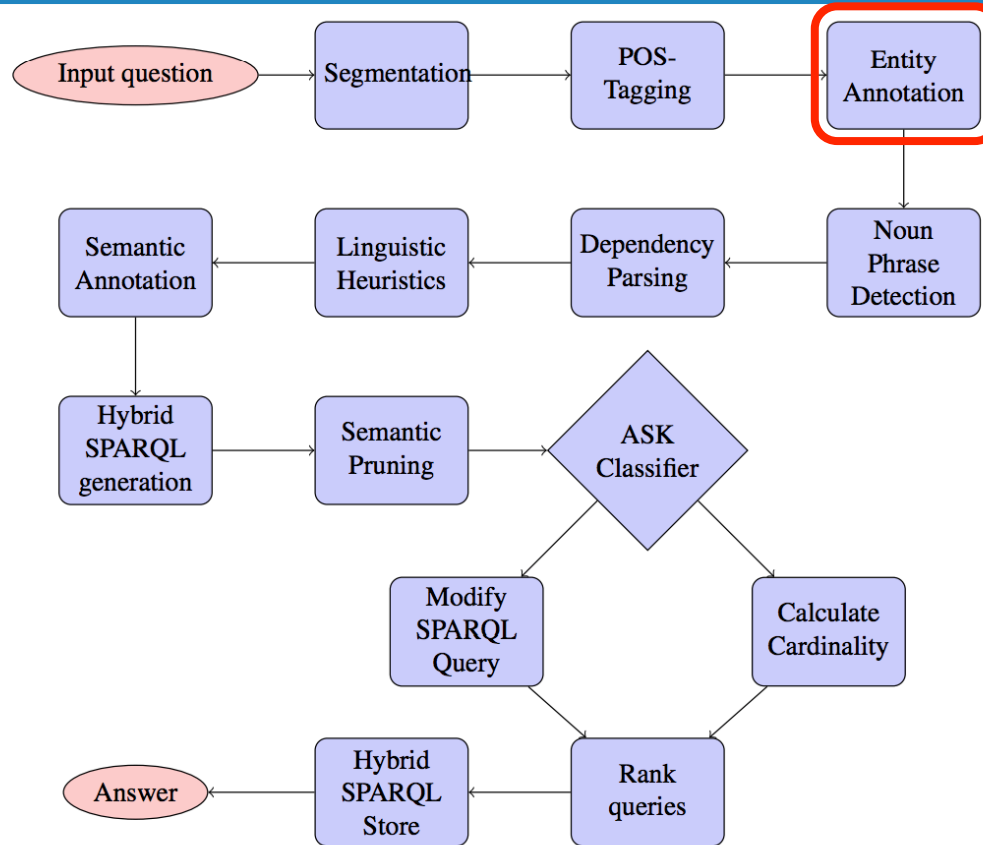
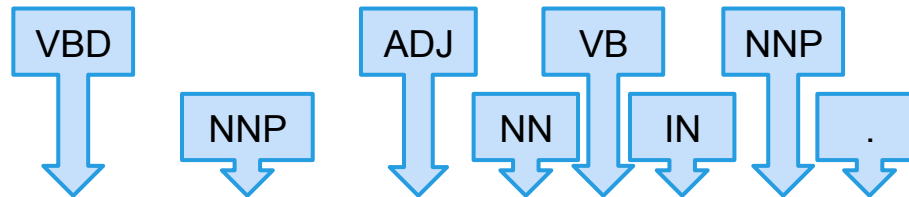


Fig. 1: Pipeline steps of HAWK.

Hawk -

Entity Annotation

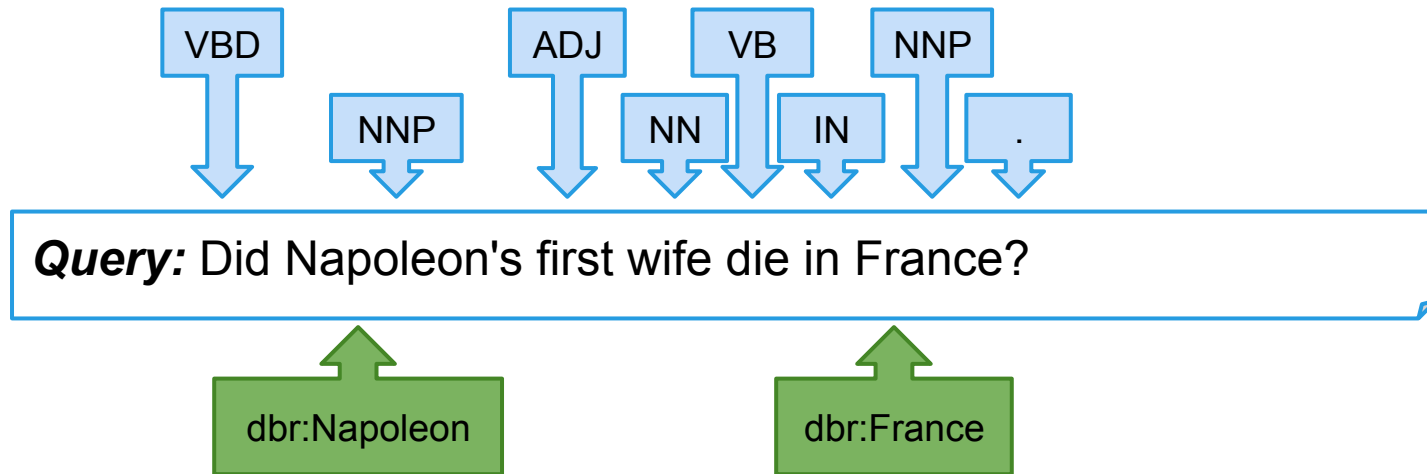


Query: Did Napoleon's first wife die in France?

- Analysed the influence of 4 different annotation systems

Hawk -

Entity Annotation



- Analysed the influence of 4 different annotation systems



Hawk - Hybrid Question Answering

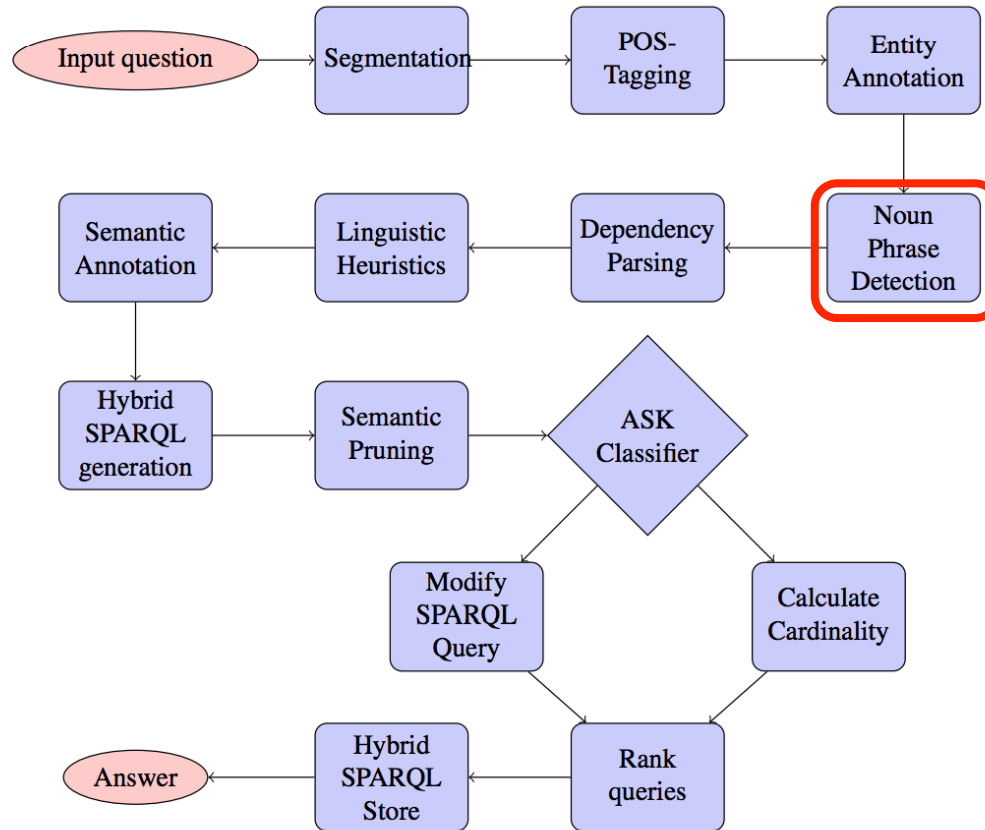
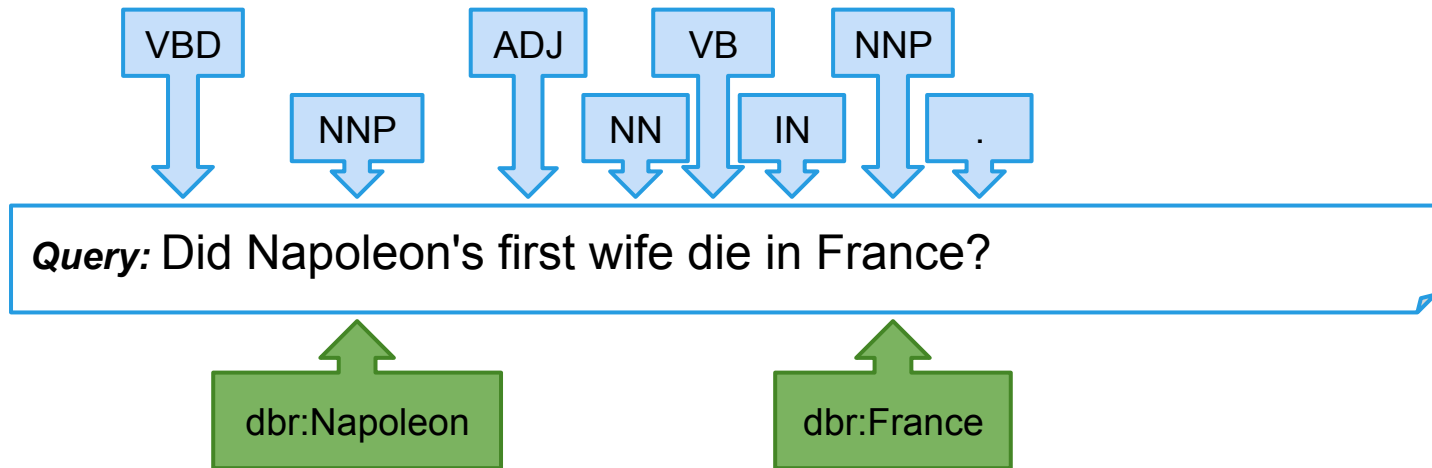


Fig. 1: Pipeline steps of HAWK.

Hawk -

Noun Phrase Detection

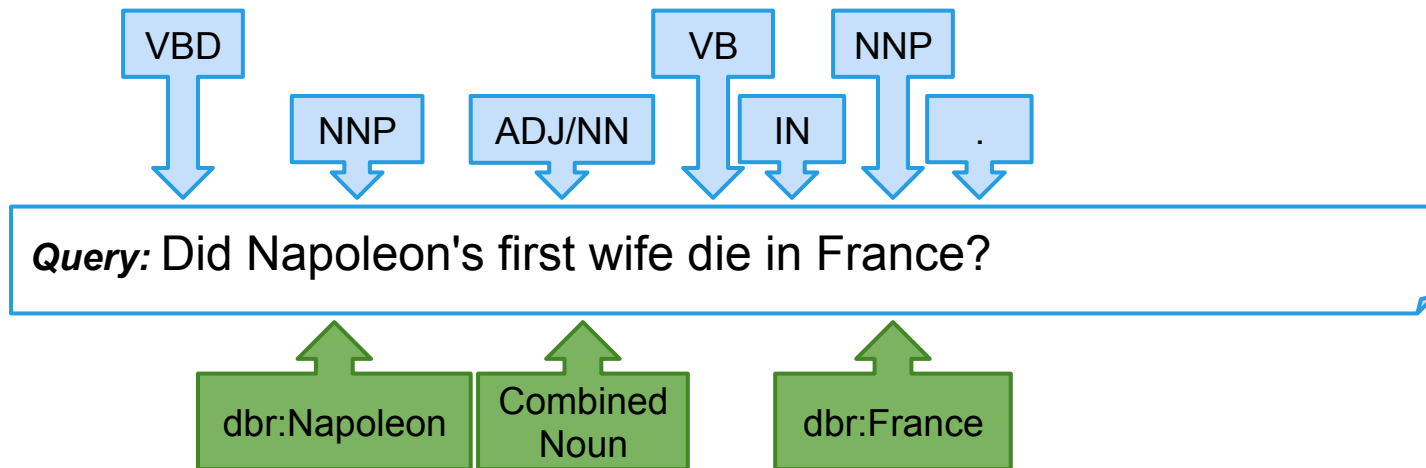


- Identify semantically meaningful word groups
- POS tag sequence rules used



Hawk -

Noun Phrase Detection



- Identify semantically meaningful word groups
- POS tag sequence rules used



Hawk - Hybrid Question Answering

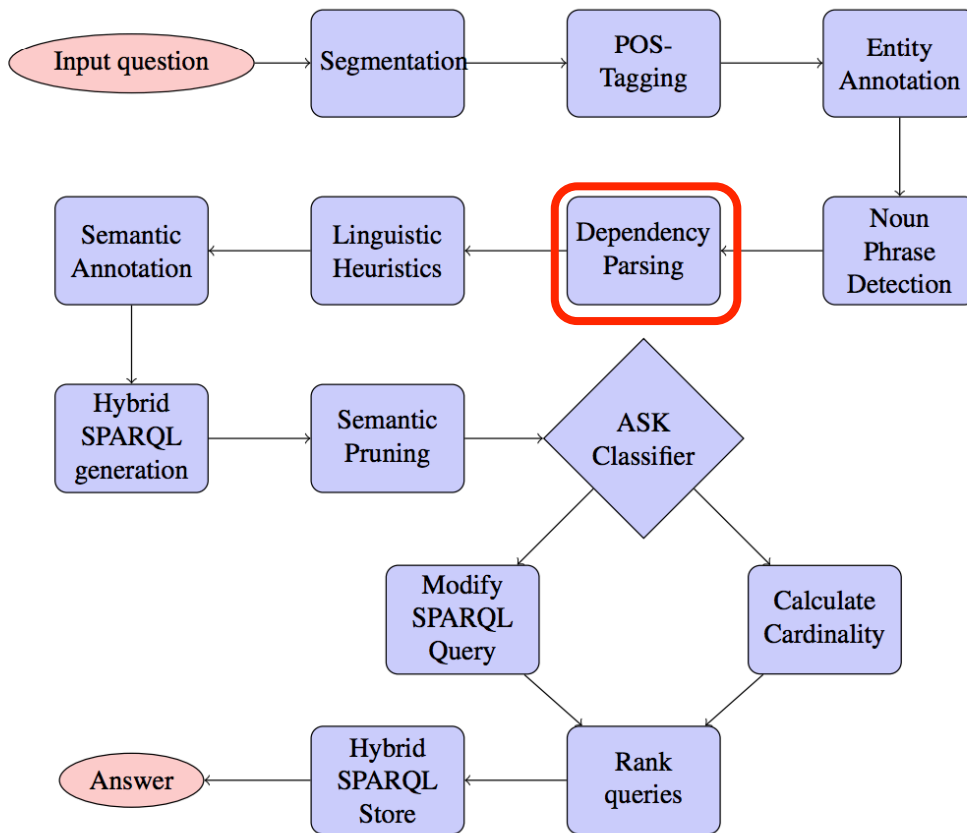
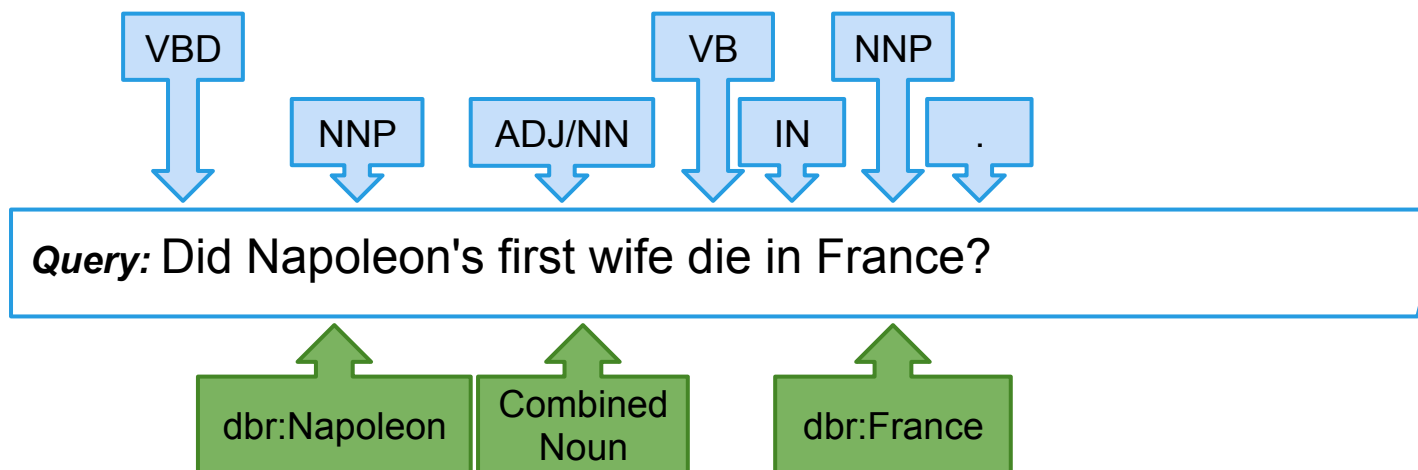


Fig. 1: Pipeline steps of HAWK.



Hawk -

Dependency Parsing

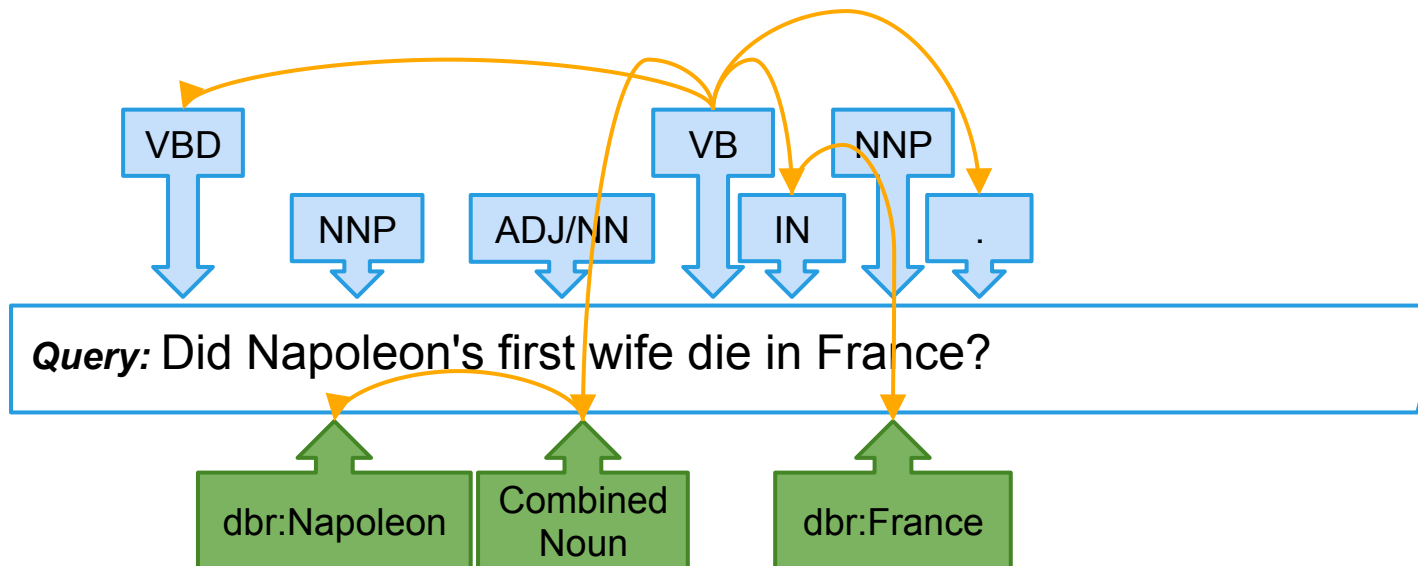


- Parsing based on predicate-argument-trees



Hawk -

Dependency Parsing



- Parsing based on predicate-argument-trees



Hawk - Hybrid Question Answering

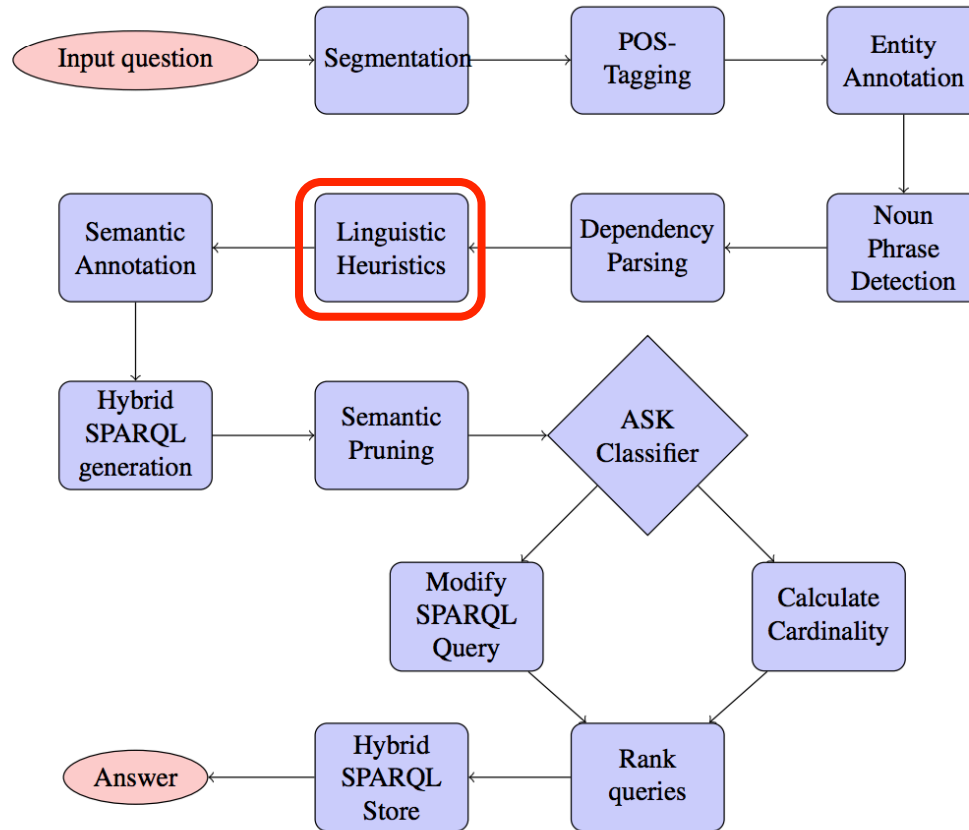
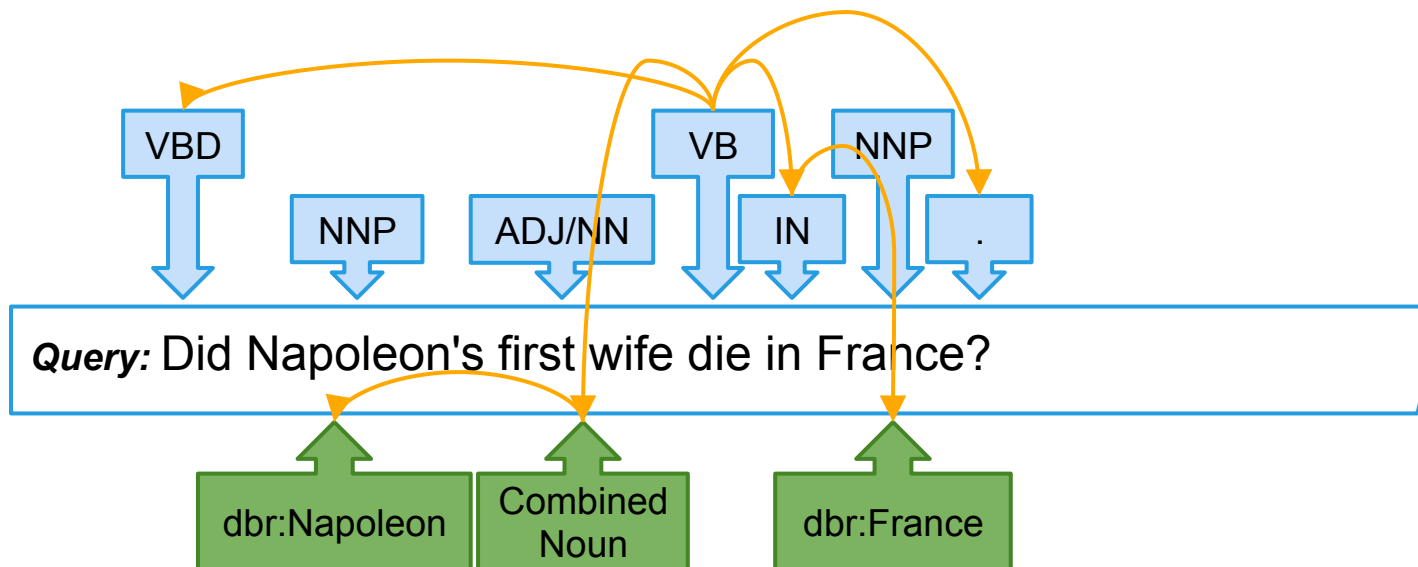


Fig. 1: Pipeline steps of HAWK.



Hawk -

Linguistic Heuristics for pruning

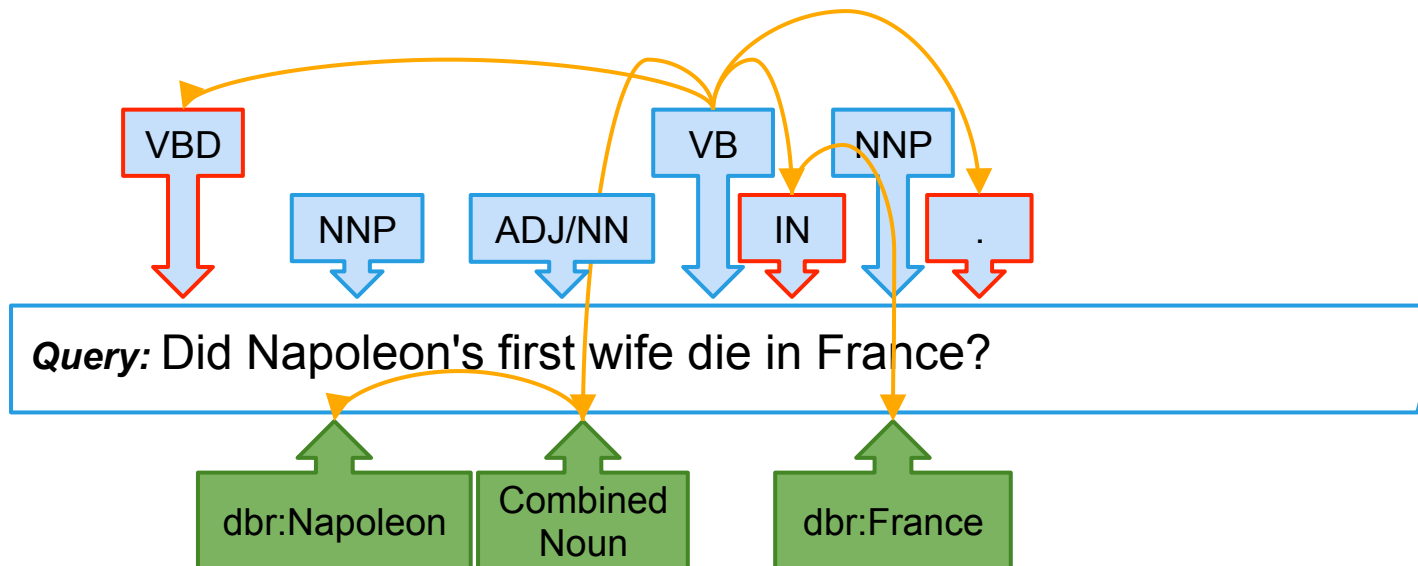


- Heuristic-based pruning of non-semantic words



Hawk -

Linguistic Heuristics for pruning



- Heuristic-based pruning of non-semantic words



Hawk - Hybrid Question Answering

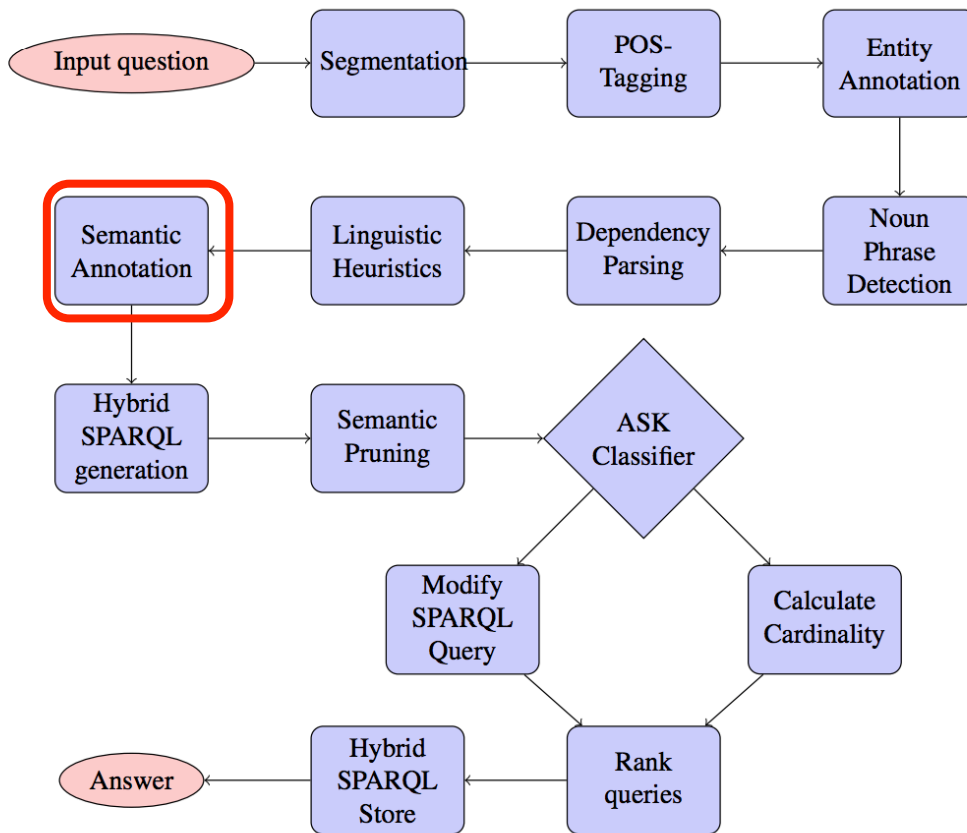
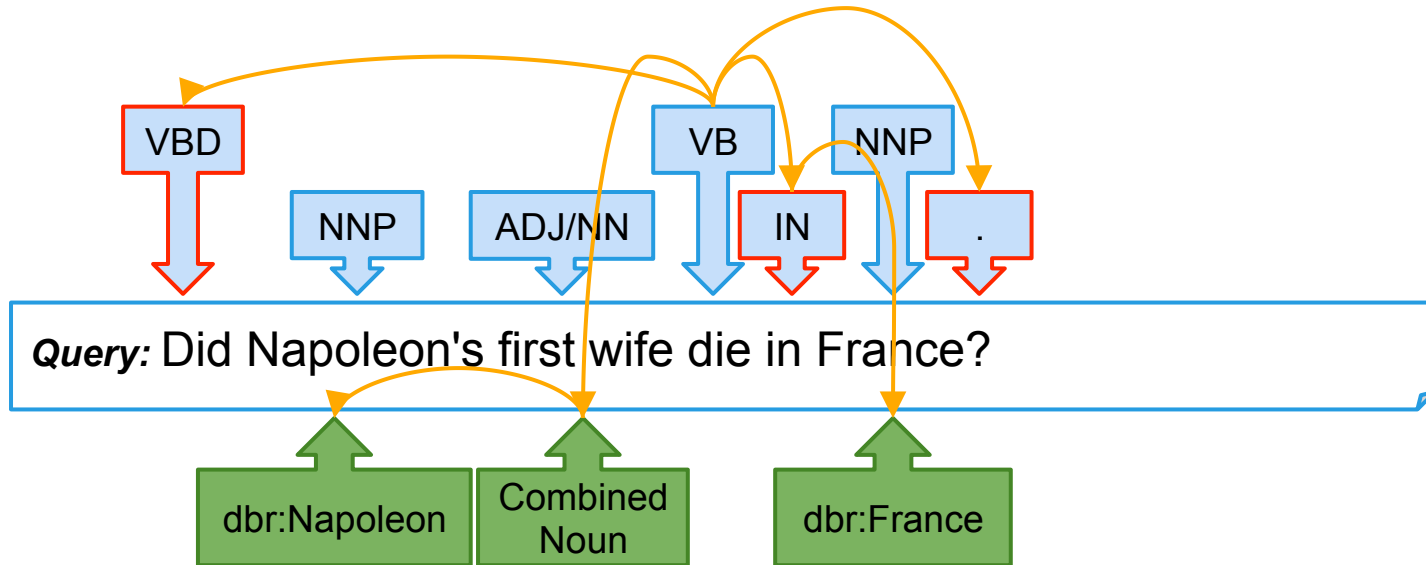


Fig. 1: Pipeline steps of HAWK.

Hawk -

Semantic Annotation

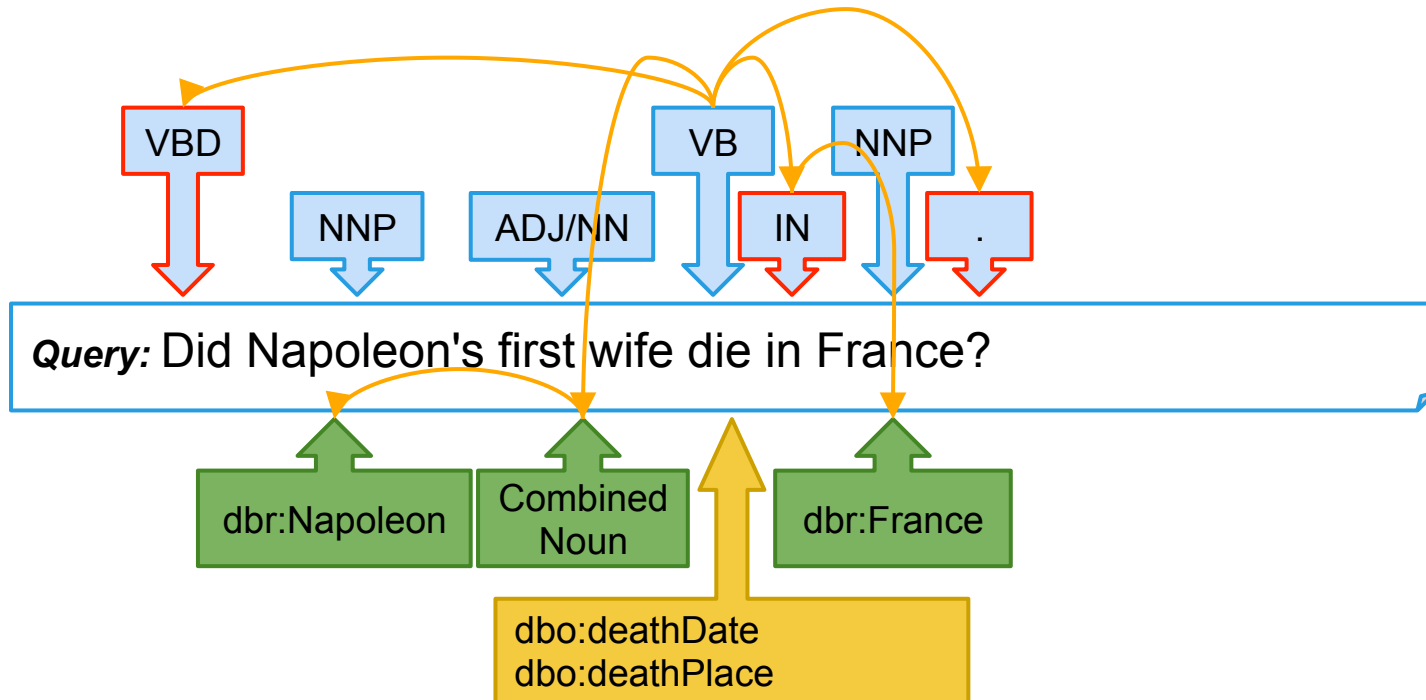


- Dictionary-based surface form search
- Ontology-based search for classes and properties



Hawk -

Semantic Annotation

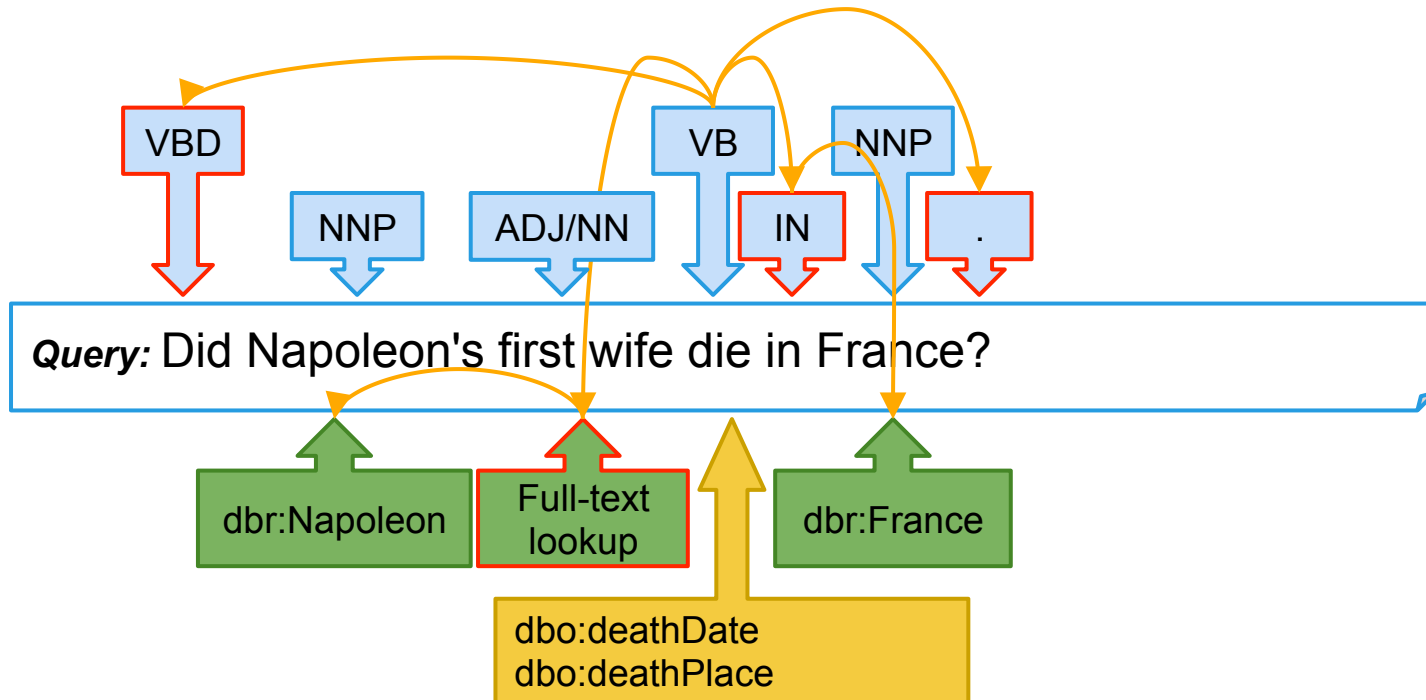


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Hawk -

Semantic Annotation



- Dictionary-based surface form search
- Ontology-based search for classes and properties



Hawk - Hybrid Question Answering

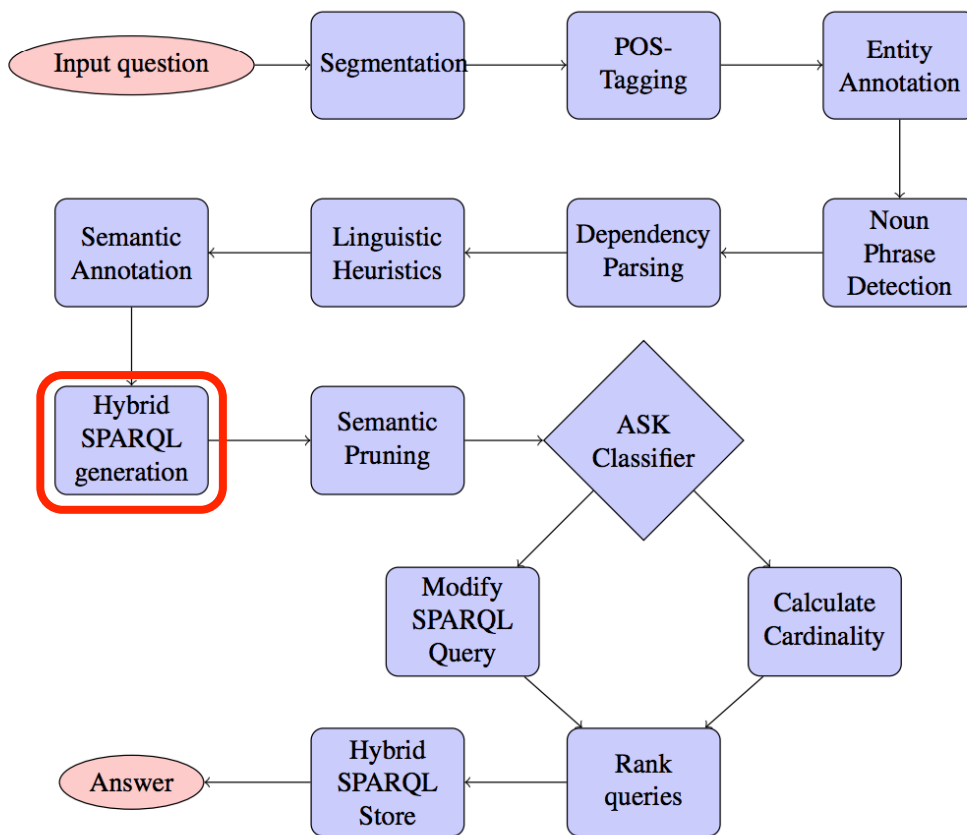
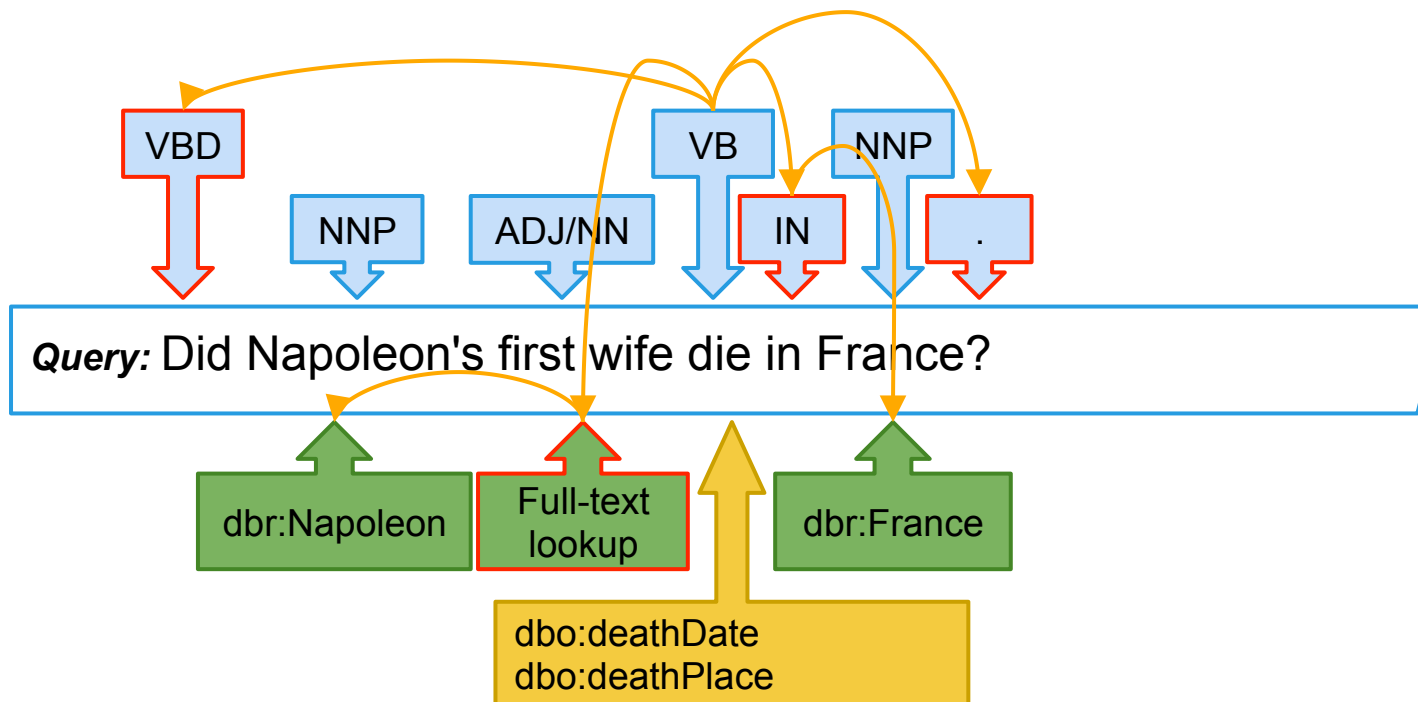


Fig. 1: Pipeline steps of HAWK.



Hawk -

Hybrid SPARQL Generation

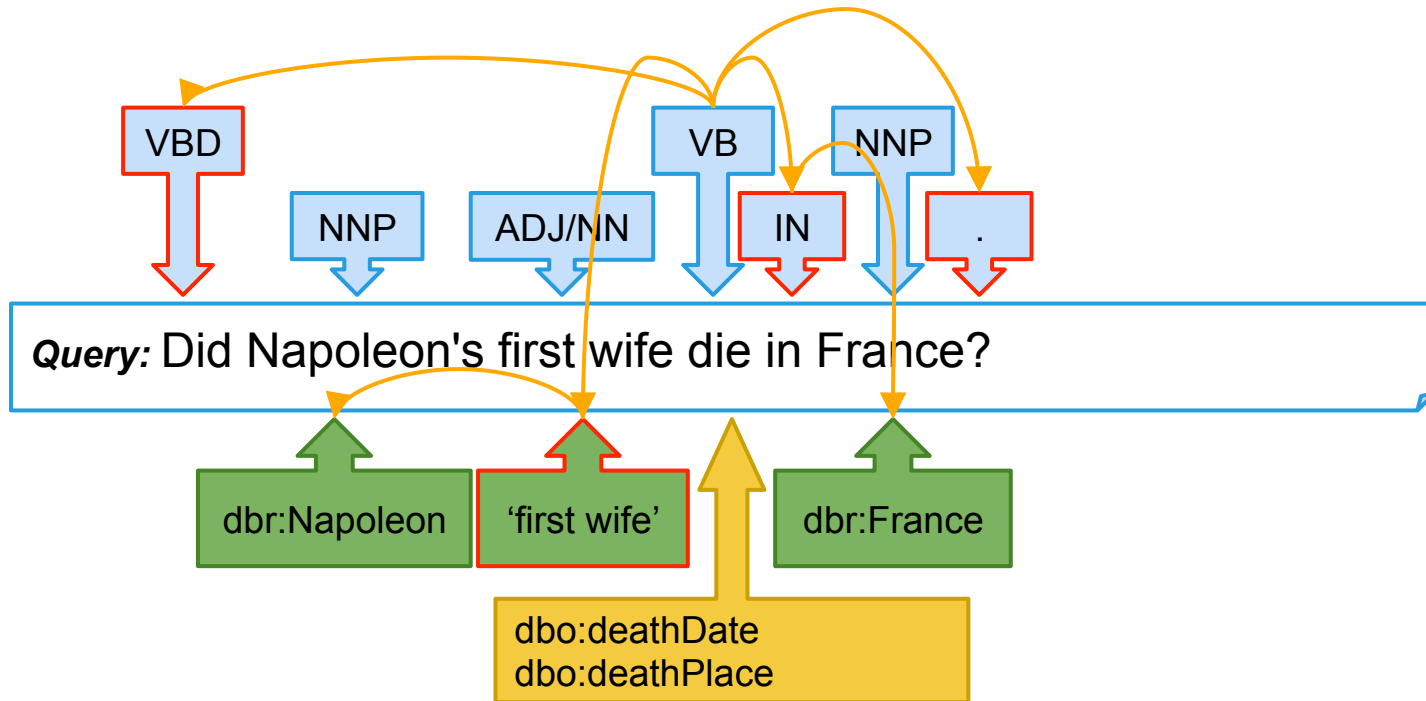


- N-fold cross-product of modules to create all possible basic graph patterns



Hawk -

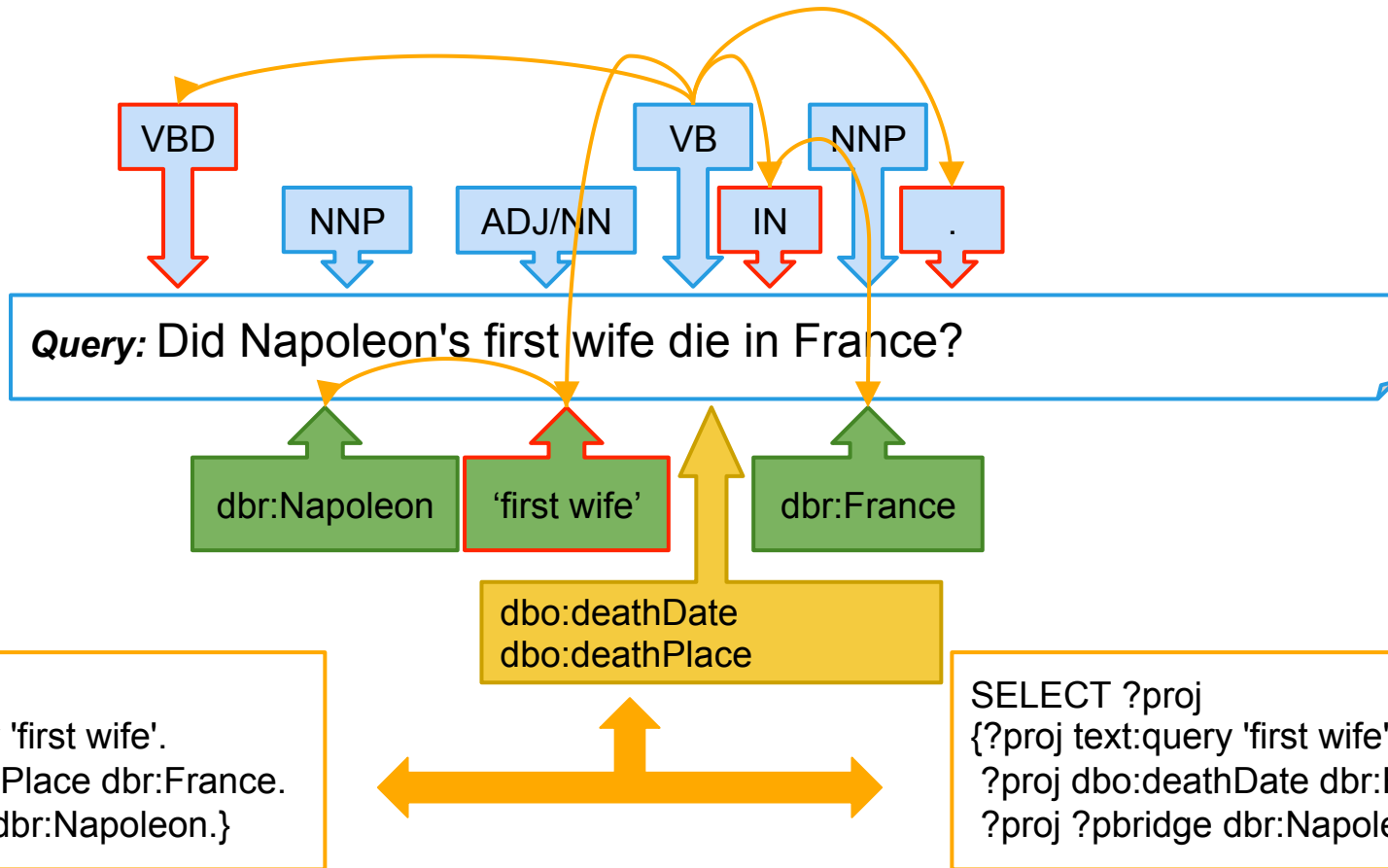
Hybrid SPARQL Generation



- N-fold cross-product of modules to create all possible basic graph patterns
- Full-text lookup

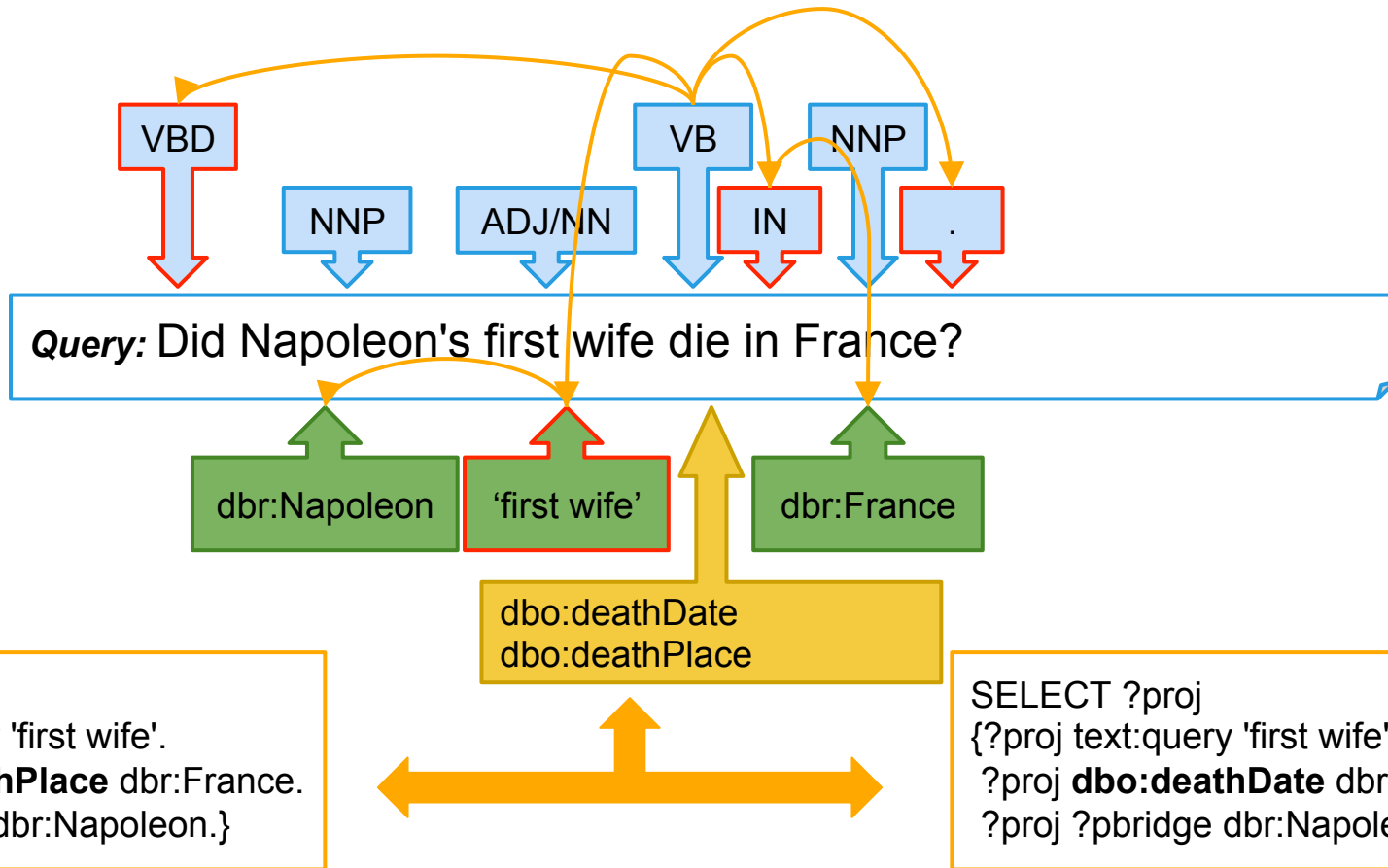
Hawk -

Hybrid SPARQL Generation



Hawk -

Hybrid SPARQL Generation





Hawk - Hybrid Question Answering

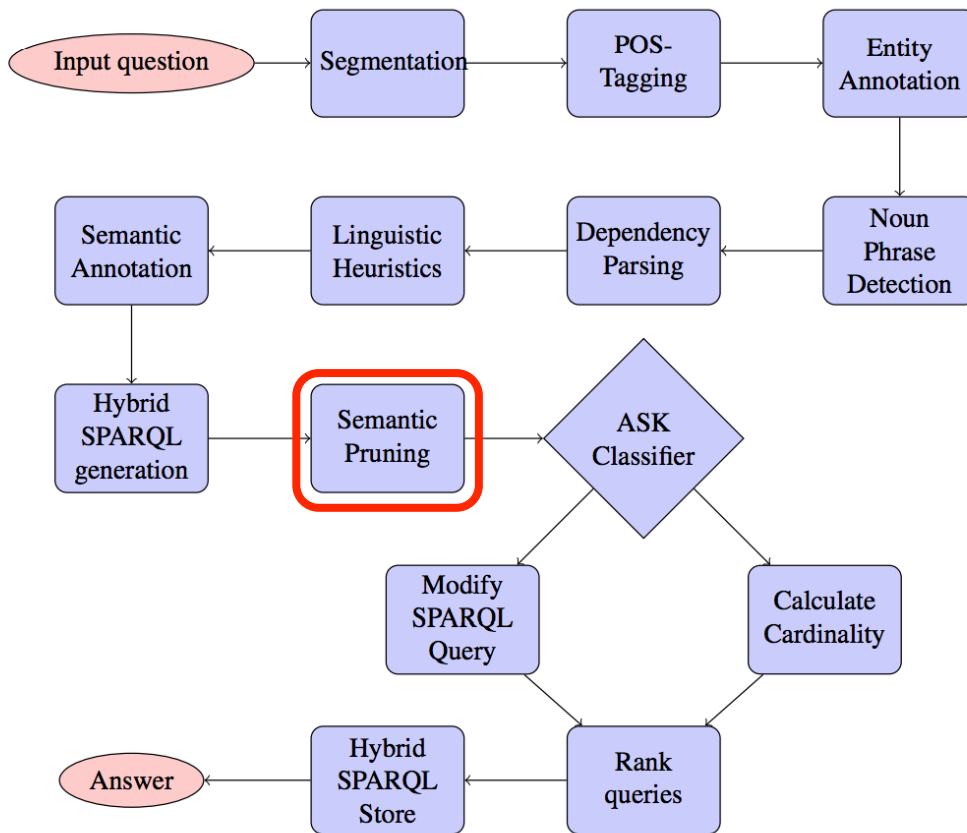
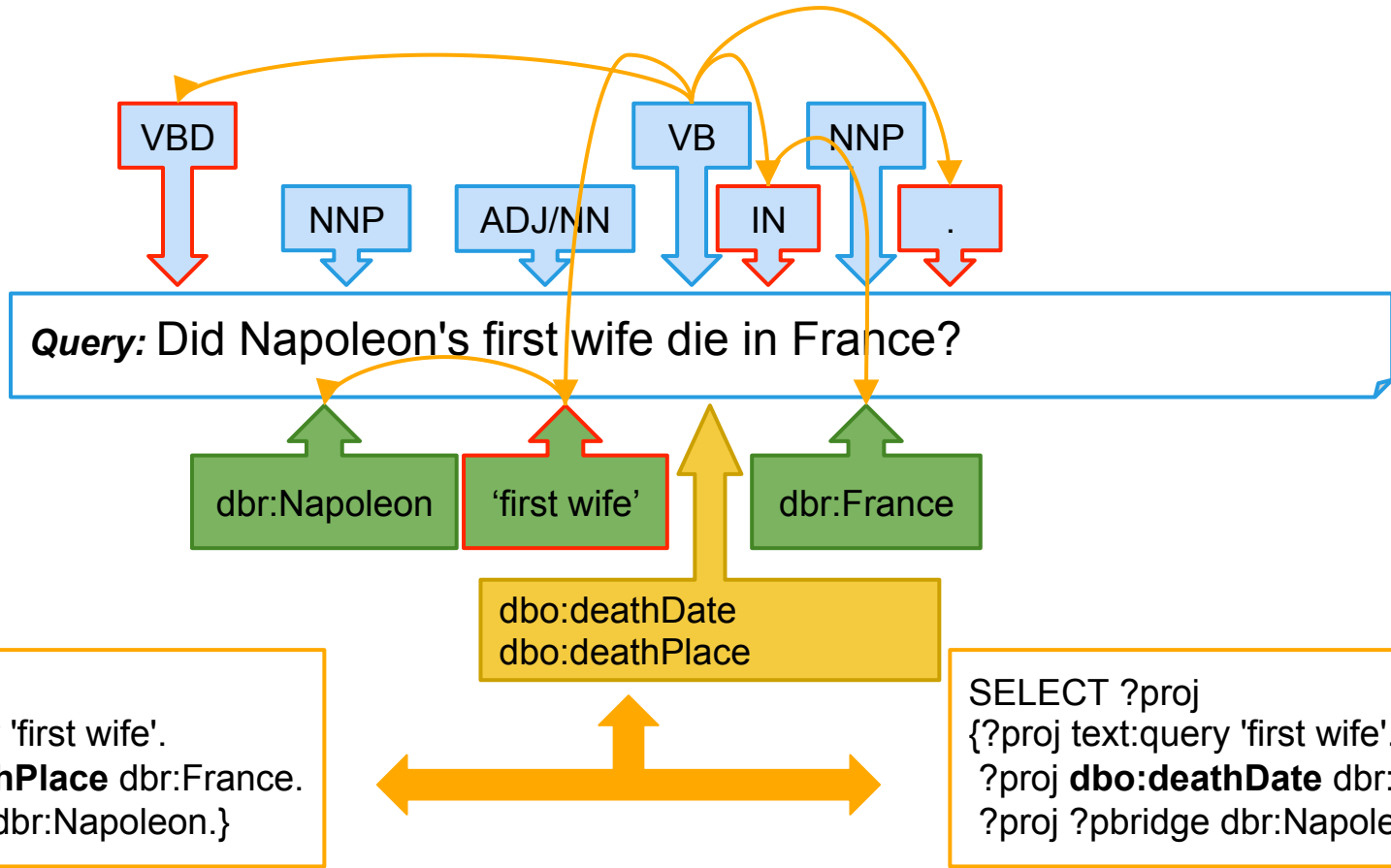


Fig. 1: Pipeline steps of HAWK.

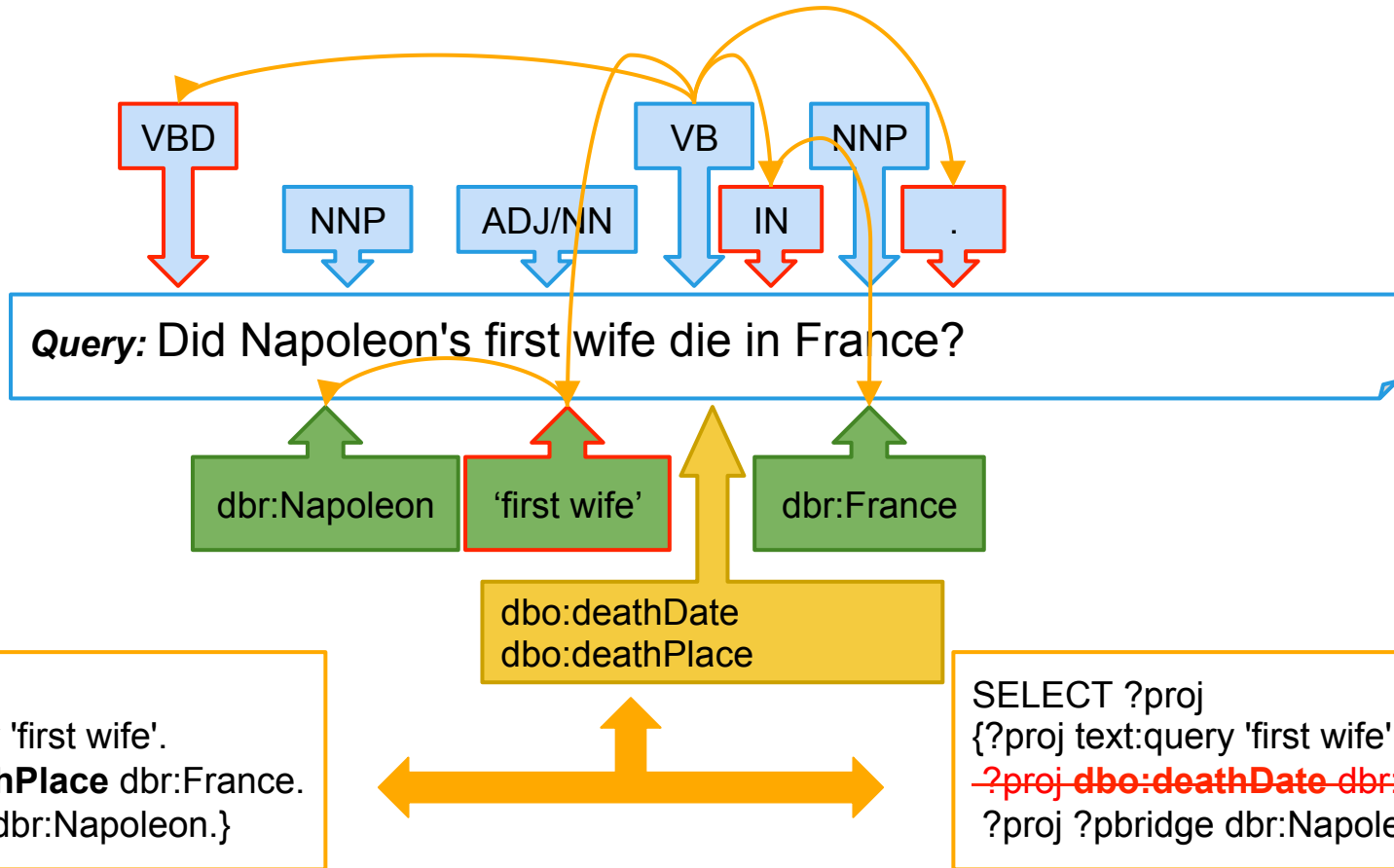
Hawk -

Semantic Pruning



Hawk -

Semantic Pruning





Hawk - Hybrid Question Answering

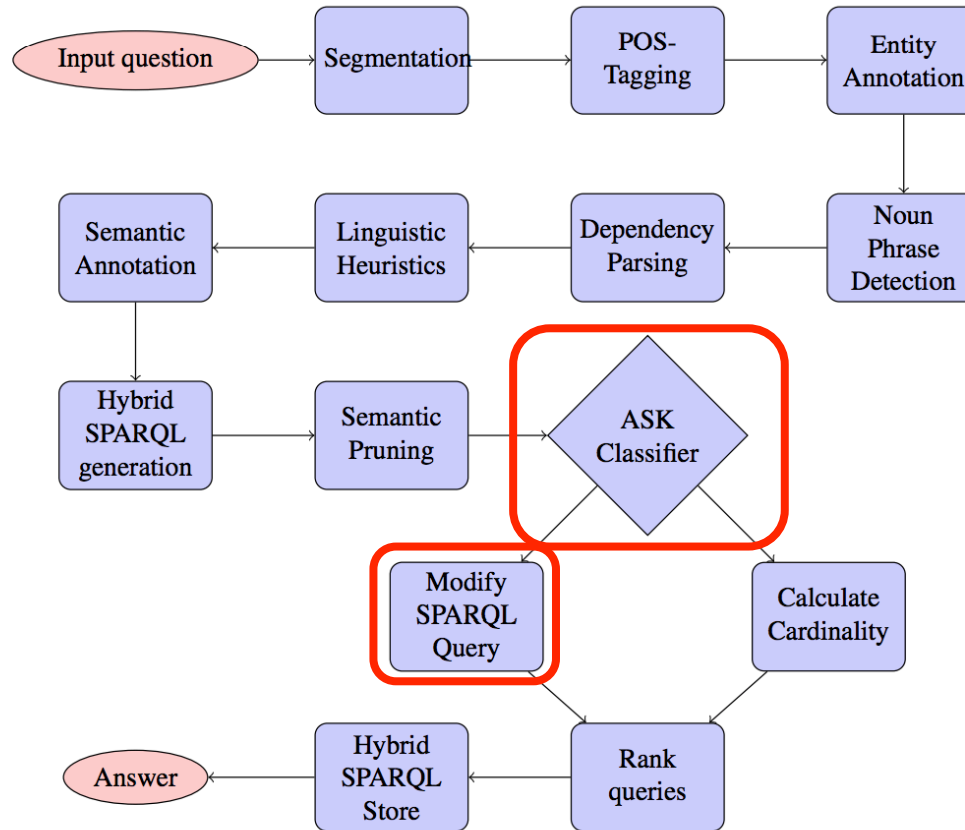


Fig. 1: Pipeline steps of HAWK.

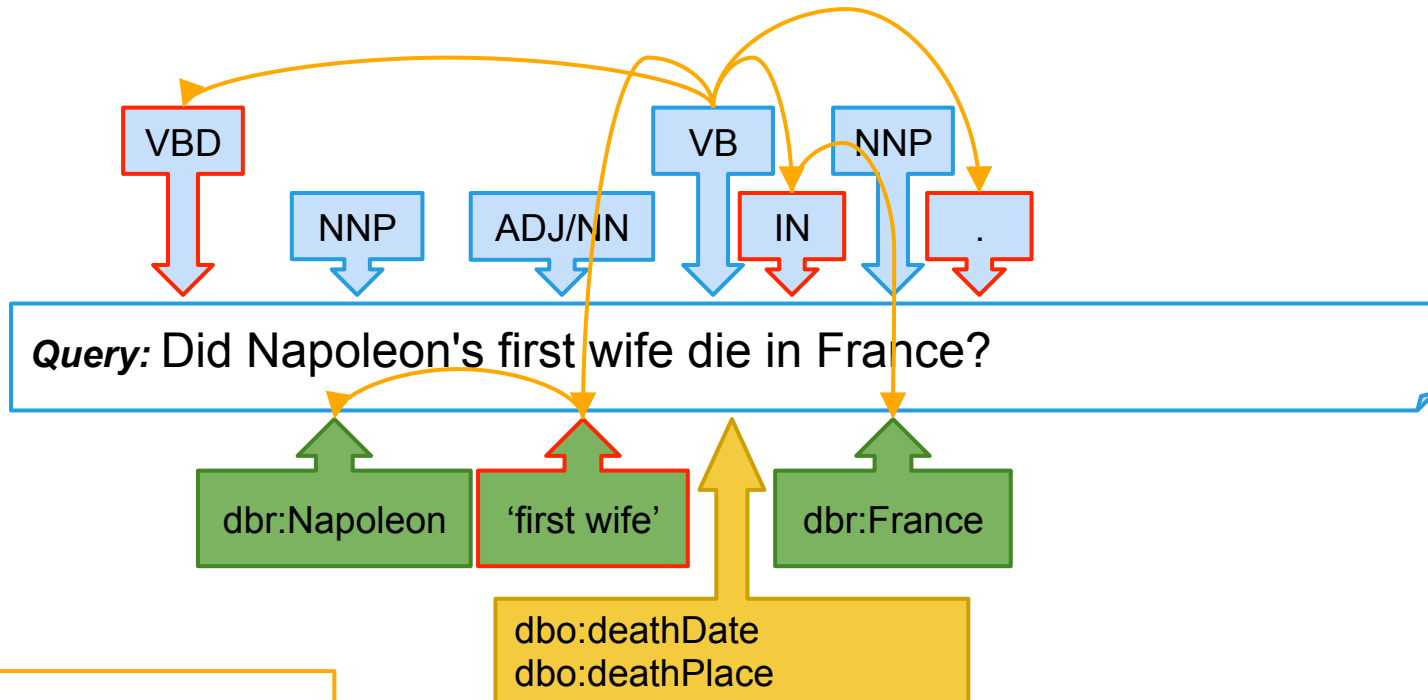


Table 1: Indicator Word for classifying ASK queries in English questions.

Indicator Word (POS-tag)	Stem form
Do (VBP), Does (VBZ), Did (VBD)	do
Is (VBZ), Are (VBP), Was (VBD)	be
Have (VBP), Has (VBZ), Had (VBD)	have

Hawk -

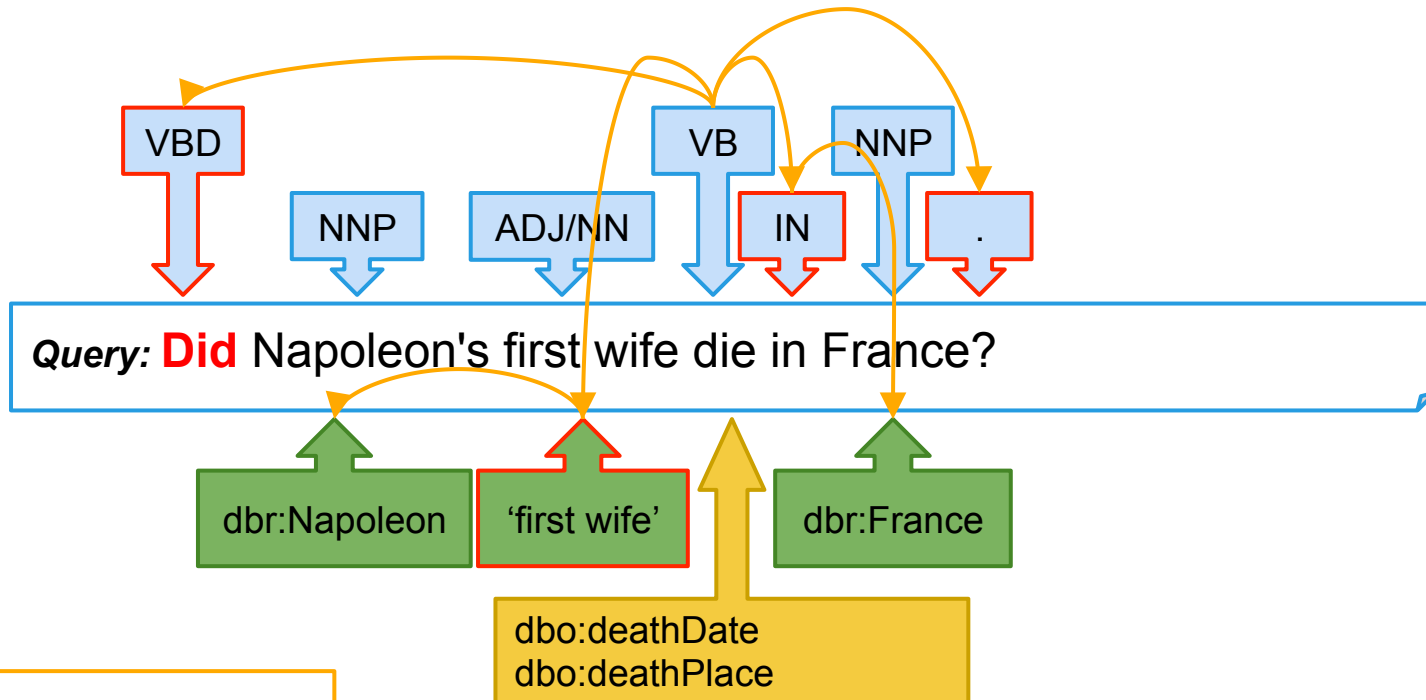
ASK Classification



```
SELECT ?proj  
{?proj text:query 'first wife'.  
 ?proj dbo:deathPlace dbr:France.  
 ?proj ?pbridge dbr:Napoleon.}
```

Hawk -

ASK Classification



ASK

```
{?proj text:query 'first wife'.  
?proj dbo:deathPlace dbr:France.  
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Hawk - Hybrid Question Answering

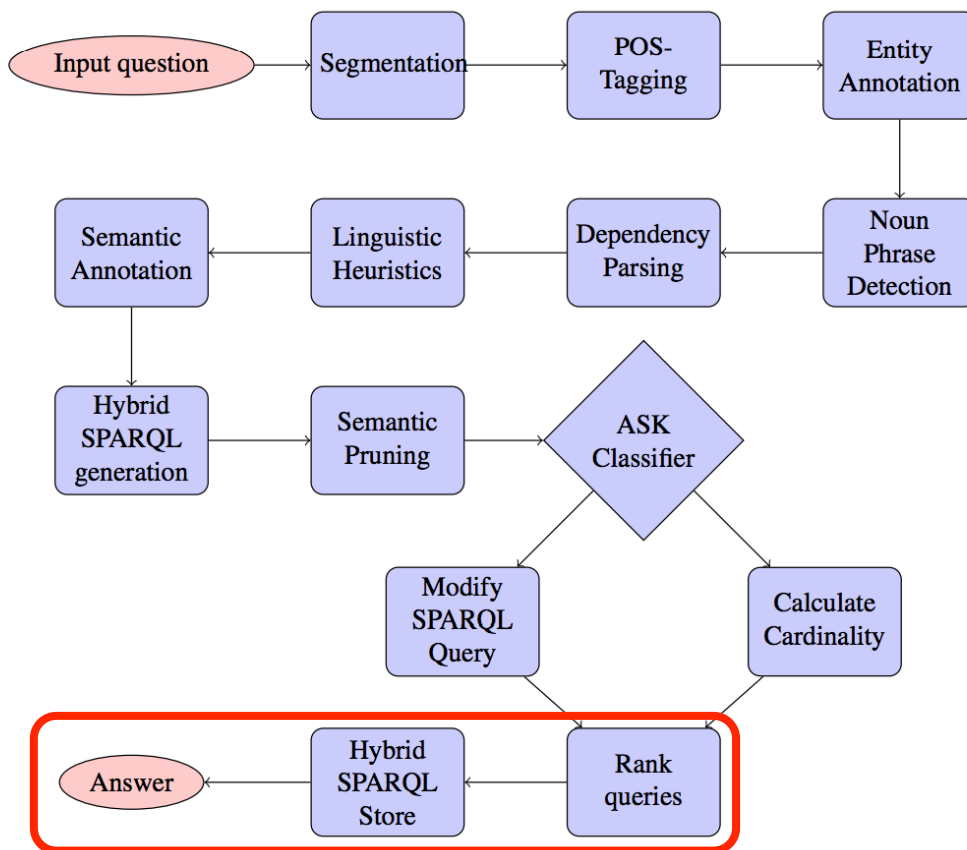


Fig. 1: Pipeline steps of HAWK.

Will not be covered in this talk.



HAWK - Evaluation

Setup

- QALD-5 only hybrid questions
 - Without Yago types, aggregations like FILTER
- 40 training, 10 test questions for hybrid QA
 - Plus boolean questions in general

⇒ 27 questions



HAWK - Evaluation

Question Type	F-measure	Global F-measure
Hybrid SELECT	0.19	0.27
Hybrid ASK	0.47	0.74
Hybrid SELECT+ASK	0.24	0.35

Table 2: Results with and without the ASK extension of HAWK.

HAWK - Conclusion

Novel, modular, hybrid question answering system

- Covers ASK questions
- Challenges:
 - Training + benchmark datasets small
 - Answering other types of queries
 - Improve ranking mechanism
 - Extend the QA ecosystem



HAWK - Conclusion

Thank you! Questions?



@akswgroup



<http://aksw.org/Projects/HAWK>
<http://github.org/aksw/hawk>



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Axel Ngonga
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Leipzig, Germany
<http://aksw.org>

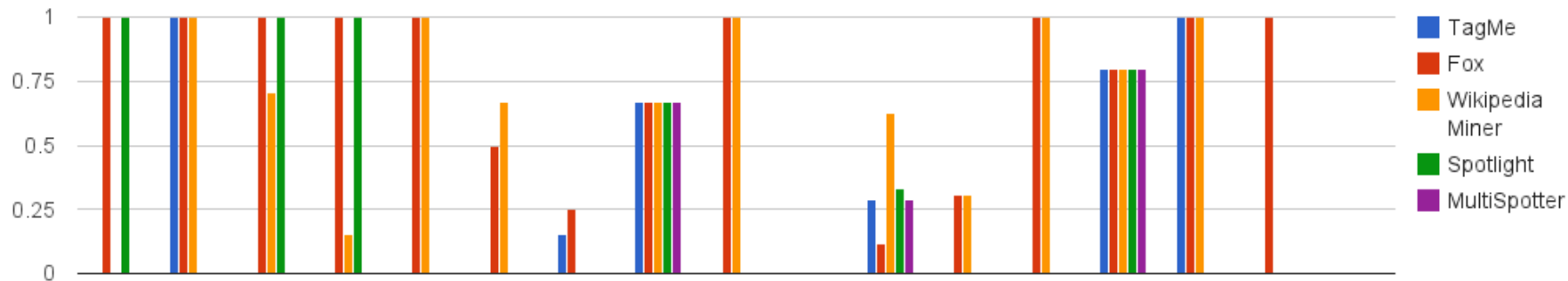


HAWK - Evaluation

Entity Annotator Influence

=> Assume an optimal ranking

- FOX = F-measure of 0.68
- Optimal annotator = F-measure of 0.58
- Union annotator = F-measure of 0.10





HAWK - Evaluation

ID	Question	F-measure	Precision	Recall
1	Give me the currencies of all G8 countries.	0.0	0.0	0.0
2	In which city was the assassin of Martin Luther King born?	1.0	1.0	1.0
3	Which anti-apartheid activist graduated from the University of South Africa?	1.0	1.0	1.0
5	Which recipients of the Victoria Cross died in the Battle of Arnhem?	0.8	0.67	1.0
6	Where did the first man in space die?	1.0	1.0	1.0
8	Which members of the Wu-Tang Clan took their stage name from a movie?	0.31	0.18	1.0
9	Which writers had influenced the philosopher that refused a Nobel Prize?	0.71	0.56	1.0
11	Who composed the music for the film that depicts the early life of Jane Austin?	0.0	0.0	0.0
14	Which horses did The Long Fellow ride?	1.0	1.0	1.0
15	Of the people that died of radiation in Los Alamos, whose death was an accident?	0.67	1.0	0.5
16	Which buildings owned by the crown overlook the North Sea?	0.25	0.14	1.0
17	Which buildings in art deco style did Shreve, Lamb and Harmon design?	0.5	0.33	1.0
18	Which birds are protected under the National Parks and Wildlife Act?	1.0	1.0	1.0
19	Which country did the first known photographer of snowflakes come from?	1.0	1.0	1.0
20	List all the battles fought by the lover of Cleopatra.	1.0	1.0	1.0
22	Which actress starring in the TV series Friends owns the production company Coquette Productions?	1.0	1.0	1.0
23	Dakar is the capital of which country member of the African Union?	1.0	1.0	1.0

- Evaluation based on QALD 4
- Assuming an optimal ranking



HAWK - Evaluation

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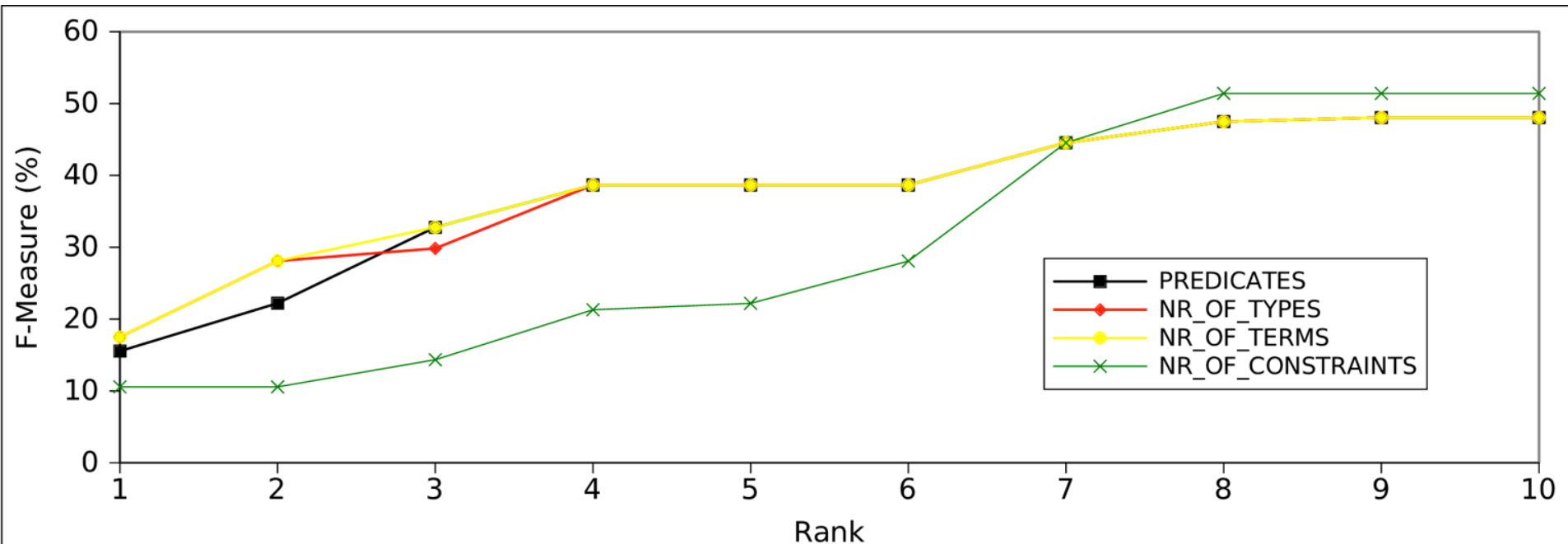
- Evaluation based on QALD 4
- Assuming an optimal ranking
- Precision = 0.70
- Recall = 0.85
- F-measure = 0.72



HAWK - Evaluation

Evaluation of Feature-based Ranking

- Rank = Number of generated SPARQL queries

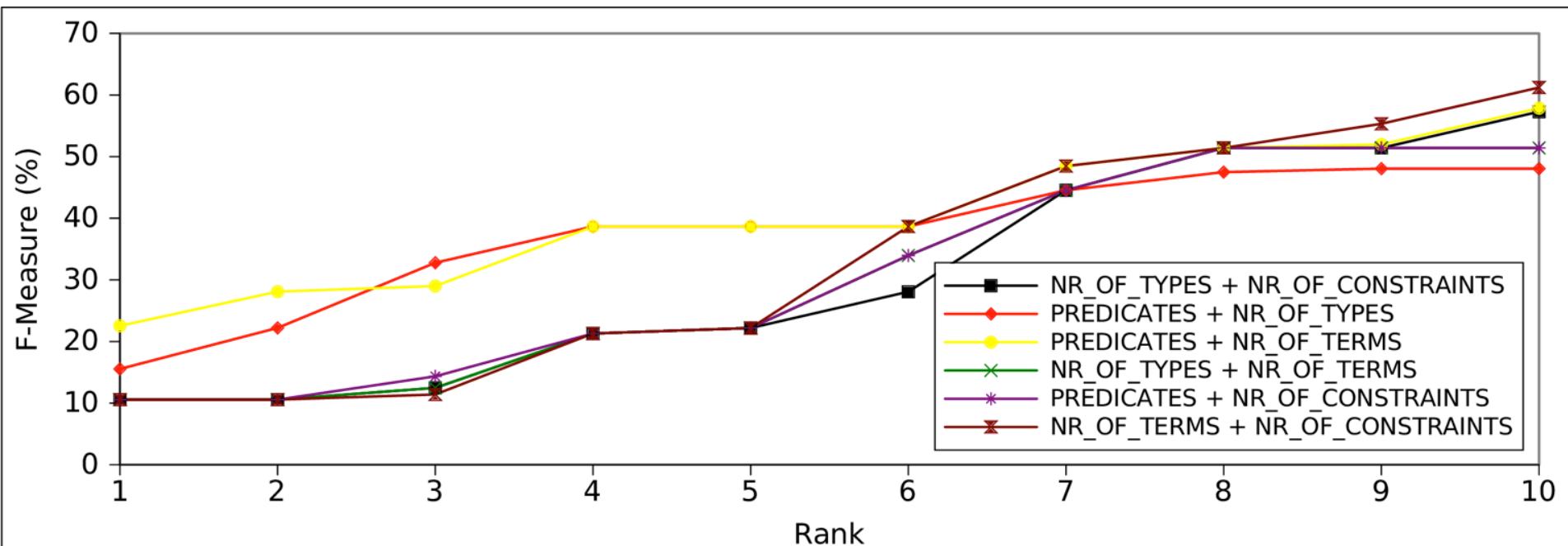




HAWK - Evaluation

Evaluation of Feature-based Ranking

- Rank = Number of generated SPARQL queries





HAWK - Evaluation

Detailed results per question

ID	Recall	Precision	F1-measure
301	1.0	1.0	1.0
303	1.0	0.5	0.67
305	0.5	0.5	0.5
306	1.0	1.0	1.0
308	0.5	0.5	0.5
309	1.0	1.0	1.0
314	0.86	1.0	0.92
315	0.5	1.0	0.67
317	1.0	0.33	0.5
318	0.67	0.67	0.67
319	1.0	1.0	1.0
320	0.23	0.42	0.29
322	1.0	1.0	1.0
323	1.0	1.0	1.0
334	1.0	1.0	1.0

- Evaluation based on QALD 5
- Assuming an optimal ranking
- Train dataset:
 - Precision = 0.30
 - Recall = 0.30
 - F-measure = 0.30
- Test dataset:
 - Only able to answer 1 Question correctly