Relation Extraction and Scoring in DeepQA

Kai Luo, Michael Yuhas

Outline

- Rule-Based Relation Extraction
- Statistical Approaches for Relation Extraction and Passage Scoring
  - Internal Representation
  - Extracting Training Data from Wikipedia and Dbpedia
  - Relation Topics
  - Relation Detection
  - Unstructured Passage Scoring
- Integrating in DeepQA
- Testing

How to Solve the Following Questions?

Jeopardy! question	*Relation detected (relations are from the DBpedia knowledge base)*
MOTHERS & SONS: Though only separated by one year in real life, she played mother to son Colin Farrell in "Alexander."	Starring (she, "Alexander")
THE DEVIL: "The Screwtape Letters" from a senior devil to an under devil are by this man better known for children's books.	Author (man, "The Screwtape Letters")
THE LONE REPRESENTATIVE: Michael Castle from this state with 3 counties: New Castle, Kent and Sussex.	Residence ("Michael Castle", state)

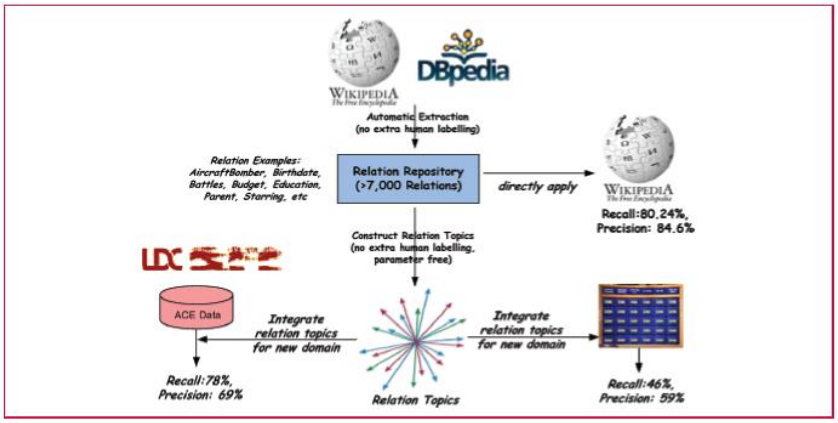
Rule-Based Relation Extraction

- Relations can be expressed multiple ways (authorOf)
- There is an unlimited number of ways to realize a relation instance
- Must manually develop rule sets

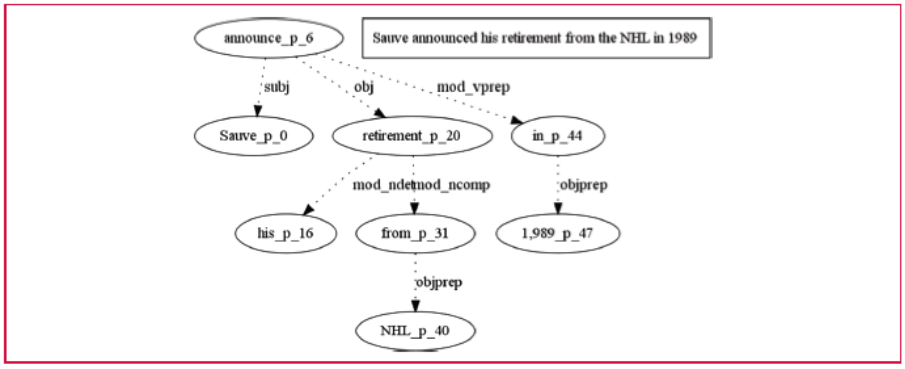
These Questions Need a Manual Rule Set

- Robert Redford and this Picket Fences star both debuted as soldiers in the 1962 drama War Hunt. (actorIn, actorOf, timeStamp)
- Born in Winsted, he practiced law in Connecticut before he wrote BUnsafe at Any Speed. (bornWhere, authorOf)
- This Norwegian star of such movies as Autumn Sonata was actually born in Japan. (nationalityOf, actorIn, bornWhere)
- The main library at the University of Northern Colorado is named for this alumnus who wrote an epic of Colorado in 1974. (namedAfter, authorOf)

Statistical Approaches for Relation Extraction and Passage Scoring



Internal Representation of Relation Instances



Extracting Training Data from Wikipedia and Dbpedia

- Collecting Training Data
- Retrieving Types for the Arguments

Relation Topics

- Training
- Testing
  - Detect Argument Pairs
  - Detect Argument Order
  - Filtering
  - Apply

Unstructured Passage Scoring with Relation Topics

- If the question and passage share few keywords, a relation detector can find relations between the question and the passage
- Using relation detectors in every passage does not work well
- Find pairs of matching terms and project the relation instances onto the relation topic space

Integrating in DeepQA

- Analysis step – identify relations
- Relation Extraction – content and question side
- Relation Extractions stored in the PRISMATIC knowledge base

Testing

Approach	*Recall*	*Precision*	*F_1 score*
Convolution tree kernel	56.7%	72.5%	0.636
Composite kernel (linear)	67.00%	73.5%	0.701
Syntactic kernel	70.5%	69.23%	0.6986
Nguyen et al. (2009) [30]	67.00%	76.60%	0.7150
Our kernel with topic features	77.88%	69.15%	0.7324

	No. relation detectors	*Recall*	*Precision*	*F_1 score*
Rule-based approach[a]	~30 relations	41.40%	83.25%	0.5530[a]
Statistical approach (without filters)	>7,000 relations	54.28%	25% (estimated)	0.3423
Statistical approach (with filters)	>7,000 relations	45.71%	59.44%	0.5168
Filters only	>7,000 relations	83.00%	—	—

[a]The rule-based approach is evaluated on nine relations.

	No. relation detectors	*Recall*	*Precision*	*F_1 score*
Rule-based approach[a]	~30 relations	41.40%	83.25%	0.5530[a]
Statistical approach (without filters)	>7,000 relations	54.28%	25% (estimated)	0.3423
Statistical approach (with filters)	>7,000 relations	45.71%	59.44%	0.5168
Filters only	>7,000 relations	83.00%	—	—

[a]The rule-based approach is evaluated on nine relations.

Conclusion

- Two approaches for relation extraction
  - Component level relation detector
  - System level candidate generator

Questions?