TIPI: Answer Type Prediction for Question Answering

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TIPI: Answer Type Prediction for Question Answering
MPI for Informatics

Answer Typing for KB-QA: Adobe TechTalk
DBIS@MPI-Inf

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29 PhD Students, 5 Post-docs from 21 countries!!
Research areas

- Named entity recognition, disambiguation and typing
- Question-answering over knowledge bases
- Credibility analysis of text
- Information extraction from Web tables
- User privacy in online forums
Question-answering

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David Ziegler
User Privacy

Joanna Asia Biega

Sedigheh Eslami
Stunning Saarbruecken
Intuition
Intuition
Intuition
Intuition

KB-QA System

who won the golden ball award in wc2014?

KB entities

Soccer player

Rugby player

Actor

Lionel Messi

Rachel Bloom

Dan Carter

KB-QA System
Intuition

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TIP!

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KB-QA: Adobe TechTalk
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Background: Knowledge Bases

- Fact knowledge bases

- Collection of subject-predicate-object (SPO) triples (millions!)

- Use type ontologies

- Useful for knowledge aggregation, browsing, search, ...

Lionel_Messi plays_for Barcelona_FC

Lionel_Messi born_in Rosario

Rosario is_located_in Argentina

Lionel_Messi type soccer_player
Background: Question Answering

- Expressed in natural language
- Entity-seeking factoid questions
- Semantic parsing formulates formal **query** for NL question

Question: Where was Lionel Messi born?

Query: Lionel_Messi born_in x?

- Query is executed over KB to fetch answer
Utility in KB-QA

Entity identification

Query formulation

Query ranking

Query execution

Fader et al. 2014
Yih et al. 2015
Yin et al. 2015
Bast and Haussmann 2015

And many more…
Utility in KB-QA

- Entity identification
- Query formulation
- Query ranking
- Query execution

Fader et al. 2014
Yih et al. 2015
Yin et al. 2015
Bast and Haussmann 2015
And many more…
Levels of implicitness

- Which soccer player won the Golden Ball award in the Soccer World Cup of 2014?

- Which footballer won the Golden Ball award in the World Cup of 2014?

- Who won the Golden Ball award in the World Cup of 2014?

- who got the 2014 golden ball?

- last golden ball
Ideas to build on…

- Question type classification (Li and Roth '02, Blunsom et al '06)
- Type coercion by Watson (Murdock et al. '12)
- Named entity typing (HYENA, FINET)
- Plug-in module (Yavuz et al. EMNLP '16)
- Manual coarse-grained types (Bast and Haussmann '15)
- Lexical types (Berant and Liang '15)
What comes when..

- Use cases
- System overview
- Type system
- Approach
- Data collection
- Evaluation
Use Cases

- Query modification
- Compatibility of decompositions
- Query re-ranking
- Answer ranking
Use Cases

- Query modification
- Compatibility of decompositions
- Query re-ranking
- Answer ranking
Query modification

- *Which footballer won the Nobel prize?*

![Diagram showing query modification process]

www.freebase.com/award/award_presenting_organization/awards_presented

x? won Nobel_prize .

base.associationfootball.soccer_player

Predict type

footballer

Add type constraint

x? type footballer

type.object.type

Instantiate main query
Compatibility of decompositions

Which Barcelona player won the Golden Ball?

Who plays for Barcelona?  |  Who won the Golden Ball?

<table>
<thead>
<tr>
<th>soccer_player</th>
<th>0.65</th>
<th>soccer_player</th>
<th>0.46</th>
</tr>
</thead>
<tbody>
<tr>
<td>hockey_player</td>
<td>0.23</td>
<td>rugby_player</td>
<td>0.35</td>
</tr>
<tr>
<td>violin_player</td>
<td>0.12</td>
<td>movie_actor</td>
<td>0.19</td>
</tr>
</tbody>
</table>
Compatibility of decompositions

Which Barcelona player won the Golden Ball?

Who plays for Barcelona?

| soccer_player | 0.65 |
| hockey_player | 0.23 |
| violin_player | 0.12 |

Who won the Golden Ball?

| soccer_player sportsperson | 0.46 |
| rugby_player | 0.35 |
| movie_actor | 0.19 |
System Overview: Training

Type system

Pattern base

Training data with distant supervision

TIPI
Which footballer won the 2014 Golden Ball?
Type System

- Freebase types (Bollacker et al. '08)

- WordNet subsets
  - POLY (Grycner and Weikum '16)
  - FINET (Del Corro et al. '15)
  - HYENA (Yosef et al. '12)
Type System

- Wikipedia categories

- YAGO types (Wikipedia + WordNet) (Suchanek et al. '07)
Approach: Pattern-based Extractor

- Leverage context-aware lexical types

- Run fewer classifiers per question

- Use lexicons to map to “valid” types

... which/what NN VB* ...

... who/what/which <be> DT+ NN ...

... what <be> NN’s NN VB* ...

... which/what NN of NN ...

Which footballer won the Golden Ball?

Who is the governor of New York?

What is Germany’s currency called?

What kind of government does UK have?
Approach: Pattern-based Extractor

- Use relation type signatures

- Extract and disambiguate relational phrases in question

- Find the type signature of the relation

- Use arguments to identify candidate types
  - `<film_actor> played_in <movie>`
  - `<sportsman> won_award <sports_award>`
  - `<person> born_in <city>`
Approach: Hierarchical Classification

- Procure training data for each type and learn a classifier

- Features
  - n-gram patterns
  - n-grams from DP
  - n-grams with entity types (NET)

- Expand with paraphrases + word2Vec
Approach: Hierarchical Classification

- Global threshold for stopping classifiers
- Sibling policy for sampling negative examples

Person: 0.91
Actor: 0.14
Sportsperson: 0.87
Soccer player: 0.68
Rugby player: 0.35
Data collection: Distant supervision

- No direct human annotated answer types for questions
- For each type, acquire training data
  - Question-answer pairs
  - Type descriptions
- Look up answer types from KB with respect to type system
Data collection: Distant supervision

**Question:** Where was F. Scott Fitzgerald educated?

**Targets:**
- St. Paul Academy
- Nardin Academy
- Princeton University
Evaluation

- To what degree typing module helps KB-QA system
- Final F-score with typing module
- Complex questions (to do)
  - How often wrong decompositions were ruled out
  - How often are we able to identify “valid” types by aggregation over decompositions
Evaluation

- WebQuestions benchmark with 5k questions
- Use query with type constraints in a learning-to-rank framework
- Significant improvement over baseline with typing

F-SCORE

<table>
<thead>
<tr>
<th>QUINT+TIPI</th>
<th>QUINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>51.0*</td>
<td>50.5</td>
</tr>
</tbody>
</table>
Representative examples

- Who played Bruce Wayne in Dark Knight? **Film_actor**
- Who did Rupert Grint play on Harry Potter? **Fictional character**
- Who led the attack on Normandy? **Military_commander**
- Where is Abraham Lincoln buried? **Place_of_interment**
- Who is in charge of Libya now? **Charge 😞**
In summary…

- Proposed method for predicting answer type based on question features
- Using type information significantly improves quality of answers on a popular benchmark
- Must plug-in with other KB-QA systems!!
- Components used may be applicable to more use cases
Open questions

- More ways to use types?
- Better pattern-based extractors?
- New features for hierarchical classifiers?
- Cleaner method for distant supervision?

Thank you 😊 !!