

EXTRACTING LINKED HYPERNYMS FROM FREE TEXT OF WIKIPEDIA ARTICLES COMBINING MACHINE LEARNING WITH LEXICO-SYNTACTIC RULES

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Galway June 20, 2017

TextExt - DBpedia Open Extraction Challenge

DBpedia type extraction

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Karel Čapek

From Wikipedia, the free encyclopedia

Karel Čapek (Czech: ['karɛl 'tʃapɛk] (④ listen); 9 January 1890 – 25 December 1938) was a Czech writer of the early 20th century. He had multiple roles throughout his career, including playwright, dramatist, essayist, publisher, literary reviewer, photographer and art critic. Nonetheless, he is best known for his science fiction including his novel *War with the Newts* and the play *R.U.R.* (*Rossum's Universal Robots*), which introduced the word *robot*.^{[1][2]} He also wrote many politically charged works dealing with the social turmoil of his time. Largely influenced by American pragmatic liberalism,^[3] he campaigned in favor of free expression and utterly despised the rise of both fascism and communism in Europe.^{[4][5]}

Čapek was nominated for the Nobel Prize in Literature seven times,^[6] but he never won. However, several awards are named after him,^{[7][6]} such as the Karel Čapek Prize, which is awarded every other year by Czech PEN Club for literary work that contributes to reinforcing or maintaining democratic and humanist values in the society.^[9] He was also a key figure in the creation of the Czechoslovak PEN Club as a part of the International PEN.^[10] He died on the brink of World War II as a result of lifelong medical condition,^[11] but his legacy as a literary figure has been well established after the war.^[4]

Contents [hide] 1 Life 1.1 Early life and education 1.2 World War I and Interwar period 1.3 Late life and death 2 Writing 3 Etymology of *robot* 4 An outline of Čapek's works 4.1 Plays 4.2 Novels 4.3 Other works 4.4 Travel books 5 Selected bibliography 6 See also



Infobox

Our approach to type extraction

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Linked Hypernyms Dataset

Algorithms

- Hand-crafted lexico-syntactic patterns (JAPE grammar)
- Type co-occurrence analysis across knowledge graphs
- Hierarchical SVM

Objective

- Complete missing types in DBpedia
- Get more specific types than in DBpedia (or DBpedia ontology)

dataset	description	English	German	Dutch					
Inference	2016-04 DBpedia release	3,8 million	1,1 million	1,1 million					
Dataset size									

Hearst patterns



... when the hypernym is a word not in DBpedia Ontology => Instance based ontology alignment



Kliegr, Tomáš, and Ondřej Zamazal. "LHD 2.0: A text mining approach to typing entities in knowledge graphs." Web Semantics: Science, Services and Agents on the World Wide Web 39 (2016): 47-61.

Hierarchical SVMs

Vaclav Havel [...] was a Czech playwright, essayist, poet, dissident and politician. ...

Amnesty International prisoners of conscience held by CzechoslovakiaCancer survivors; Charter 77 signatories;





Evaluation with crowdsourcing

 Randomly selected entities from Wikipedia were assigned types by at least three annotators

Wikipedia article: http://en.wikip	edia.org/wiki/Marja_van_d	er_Tas (clic	k to open!).	
Assign category				
politi	Search			
Search Posults	Family	0	Politician	President
	Dorson			DrimoMinistor
Agent > Person >	Person	€	Select this category	Primeiviinister
Politician	Organisation	Ð	Managah	Deputy
Agent > Organisation >	Deity		Monarch	Congressman
PoliticalParty			PlayboyPlaymate	Senator
			Toluziai-Douronality	Schator

- Used annotator agreement to establish groundtruth
- Gold standard with 2000 entity type assignments

Evaluation metrics

• Exact precision

$$P_{exact} = \frac{\sum_{i} |P_i \cap T_i|}{\sum_{i} |P_i|},$$

• Hierarchical precision, recall and F-measure

$$hP = \frac{\sum_{i} |\hat{P}_{i} \cap \hat{T}_{i}|}{\sum_{i} |\hat{P}_{i}|}, \qquad hR = \frac{\sum_{i} |\hat{P}_{i} \cap \hat{T}_{i}|}{\sum_{i} |\hat{T}_{i}|}, \qquad hF = \frac{2 * hP * hR}{hP + hR},$$

where \hat{P}_i is the set of the most specific type(s) predicted for test example *i* and all its (their) ancestor types and \hat{T}_i is the set of the true most specific type(s) of test example *i* and all its (their) ancestor types.



Hierarchical precision





Hierarchical recall





Evaluation results

Classifier	GS3 (randomly drawn articles)							
	entities	P _{exact}	hP	hR	hF			
DBpedia	715	.537	.902	.611	.729			
SDType								
Core	402	.654	.864	.371	.519			
STI prune	379	.449	.754	.274	.403			
$hSVM_{text}\alpha$	750	.307	.747	.597	.663			
$hSVM_{text}STI\alpha$	765	.327	.757	.621	.682			
$Core + STI_{prune}$	781	.554	.814	.645	.720			
$Core + hSVM_{text} STI\alpha$	864	.439	.786	.720	.752			
$Core + STI_{prune} + hSVM_{text} \alpha$	<u>896</u>	.465	.800	.724	.760			

- LHD lexico-syntactic patterns match/exceed exact precision of DBpedia (infoboxes)
- LHD hSVM have lower precision, but higher recall than DBpedia

Comparison with state-of-the-art

Paulheim, Heiko, and Christian Bizer. "Type inference on noisy rdf data." International Semantic Web Conference. Springer Berlin Heidelberg, 2013.

Classifier	Pexact	hP	hR	hF
STI prune	.446	.780	.589	.671
$STI + hSVM_{text} \alpha$.400	.763	.734	.748
$hSVM_{text}^{add}\beta$.365	.719	.706	.712
$hSVM_{text}^{add}STI\beta$.294	.817	.652	.726
DBpedia (2014)	.548	<u>.890</u>	.665	.761
GS2				
SDType (3.9)	.338	.809	.641	.715

Evaluation on gold standard GS1 (1021 entities) and GS2 (160 entities).

Excerpt of results from our LHD 2.0 paper

- Results for our approach are comparable to SDType in terms of hP and hR
- We found that SDType and our approach are largely complementary w.r.t. entities covered
- SDType types entities based on ingoing/outgoing links (properties) why our approach uses text

Challenges for DBpedia integration

- Different programming language
- Many dependencies
- Separation of concerns
- Scalability

Dockerized LHD framework



LHD Installation instructions

Documentation has more than 2000 words

VS

Docker BUILD and RUN

Two commands

> docker build -t lhd https://github.com/KIZI/LinkedHypernymsDataset.git#:docker > docker run -d --env-file <path-to-env-vars-file> lhd <language> <dbpedia-version>

Only need to specify URLs to DBpedia datasets

ner.vse.cz/thd

Entityclassifier.eu NER 🐉

Recognition, Classification, Linking of Salient Named Entities

github.com/entityclassifier-eu/

- Entity spotting
 - TreeTagger + GATE JAPE
 - Stanford NER
- Entity linking
 - String similarity
 - Lucene
 - Wikipedia Search
 - Surface form index
- Entity salience
 - SVM
- Languages
 - English, German, Dutch

- Knowledge bases
 - DBpedia, YAGO, LHD
- Stability
 - The system runs since 2012
 - Was used to annotate hundreds of thousands web pages
- Benchmarks
 - NIST TAC 2013, 2014
 - The Wikipedia search method had median performance in TAC 2013
 - GERBIL

Extraction, Disambiguation and Classification of Entities and Named Entities



Results

The Charles Bridge is a famous historic bridge that crosses the Vltava river in Prague, Czech Republic.

Inbeat.eu: Our "Orwellian Eye"



Tomáš Kliegr, Jaroslav Kuchař: Orwellian Eye: Video Recommendation with Microsoft Kinect. In: Prestigious Applications Of Intelligent Systems. ECAI 2014. IOS Press

Demo 2/2 Inbeat.eu

Publications

LHD algorithms

- T. Kliegr: Linked hypernyms: Enriching DBpedia with Targeted Hypernym Discovery. Journal of Web Semantics, Elsevier, 2015
- T. Kliegr and O. Zamazal: LHD 2.0: A text mining approach to typing entities in knowledge graphs. Journal of Web Semantics. Elsevier, 2016

LHD framework

 T. Kliegr, V. Zeman and M. Dojchinovski. Linked Hypernyms Dataset - Generation Framework and Use Cases. 3rd Workshop on Linked Data in Linguistics: Multilingual Knowledge Resources and Natural Language Processing, At Reykjavik, Iceland. 2014

Applications/Use cases

- M. Dojchinovski and T. Kliegr: Entityclassifier.eu: Real-time Classification of Entities in Text with Wikipedia, European Conference on Machine Learning (ECML PKDD'13). Prague, Czech Republic, Springer, 2013
- T. Kliegr, J. Kuchař: Orwellian Eye: Video Recommendation with Microsoft Kinect. Prestigous Applications of Intelligent Systems, European Conference on Artificial Intelligence (PAIS/ECAI 2014), Prague, Czech Republic, IOS PRESS, 2014

Credits and resources

Dataset

ner.vse.cz/datasets/linkedhypernyms

- Supplementary datasets (fine grained types, ontology alignment)
- Evaluation resources: gold standard datasets, guidelines, etc.

github.com/KIZI/LinkedHypernymsDataset

LHD generation framework wrapped in Docker container

github.com/OndrejZamazal/hSVM3

hSVM implementation

github.com/kliegr/hierarchical evaluation_measures

Evaluation of DBpedia entity type algorithms

Use cases

ner.vse.cz/thd & github repositories

Inbeat.eu & github repository

- Free to use API and open source entity classification software
- GATE plugin

Milan Dojchinovski

Inbeat semantic recommenders with sensor support



Jaroslav Kuchař

Václav Zeman







Ondřej Zamazal



The master resource

dbpedia.org

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*													
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					Dowr	nloads		
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infobox test	tql ? ttl ?	tql ? ttl ?	tql ? ttl ?	tql ? ttl ?	tql ? ttl ?	tql ? ttl ?	tql ? ttl ?	tql ? ttl ?
Instance Types	tql ? ttl ?	tql ? tql* ? ttl ? ttl* ?						
Instance Types Dbtax Dbo	ttl ?							
Instance Types Dbtax Ext	ttl ?							
Instance Types Lhd Dbo	ttl ?	ttl ?				ttl ?		

Dataset preview

LHD Core: Types in DBpedia ontology

<http://dbpedia.org/resource/Mizda-Brak_Road>
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>
<http://dbpedia.org/ontology/Road> .

<http://dbpedia.org/resource/Thiruchendur_Express> <http://www.w3.org/1999/02/22rdf-syntax-ns#type> <http://dbpedia.org/ontology/Train> .

LHD Extension: Finer grained types

<http://dbpedia.org/resource/Conus_brunneofilaris> <http://purl.org/linguistics/gold/hypernym> <http://dbpedia.org/resource/Snail> .

<http://dbpedia.org/resource/Tyttö_sinä_olet_meritähti> <http://purl.org/linguistics/gold/hypernym> <http://dbpedia.org/resource/Debut> .





http://ner.vse.cz/datasets/linkedhypernyms/